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ABSTRACT

As part of California's comprehensive program to improve and strengthen its schools by incorporating educational technology into the entire curriculum, funds have been provided to school districts that have developed an educational technology or computer education plan. This guide identifies planning activities and describes steps district personnel can follow in developing their programs. It is organized according to five major steps in the planning process: (1) planning preliminary activities; (2) integrating computers into the curriculum; (3) delivering staff development services; (4) acquiring hardware and software; and (5) organizing and implementing the program. This publication may also be used as a reference manual, part of a staff development program, or in conjunction with training seminars. The approach to computer education is curriculum based and focuses on ways in which the curriculum can be improved by use of the computer. Staff training is allocated according to curriculum priorities, and hardware and software acquisitions are matched to application needs. This guide provides a comprehensive program plan, not only to help users find solutions, but also to help practitioners develop their own responses to needs within their districts. (DJR)

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Computer Applications Planning

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PREFACE

California has begun a comprehensive program to improve and strengthen its schools. Various reform strategies were inaugurated through Senate Bill 813 (1983), which mandated structural reforms and made substantial funding available. Increased graduation requirements, lengthened school days and years, tighter discipline, and other features of Senate Bill 813 have been implemented over the past two years. In addition legislative action, through Assembly Bill 803 (1983), has provided the impetus for building strong local educational programs and for incorporating educational technology to enhance and strengthen the entire curriculum. Assembly Bill 803, the educational technology local assistance program, provides funds to school districts that have developed and implemented a comprehensive districtwide educational technology or computer education plan. Such a plan, which seeks out applications across all curricular areas and embodies characteristics of effective schools, such as academic focus, coordinated curriculum, variety of teaching strategies, and high standards and expectations, will provide districts with an opportunity for improving and strengthening their overall instructional program.

Districts vary, however, in the extent to which they have developed and implemented a computer education plan. Many districts have encouraged teacher training and may have begun isolated classroom computer applications. This publication, written for district staff members who have systemwide responsibilities for designing and implementing a computer education program in their districts, will serve districts that are just beginning their planning efforts as well as districts that have already developed a plan. The steps and processes described can serve as a checklist for the latter as they continue the process of updating a computer education plan. Districts need not stop their computer application activities while they are developing a comprehensive computer education plan. Although some existing activities may be delayed or modified during planning, computer applications can serve as models for future activities.

This publication, *Computer Applications Planning*, identifies essential planning activities and describes steps district personnel can follow in developing their programs. It is organized according to five major steps in the planning process: (1) planning preliminary activities; (2) integrating computers into the curriculum; (3) delivering staff development services; (4) acquiring hardware and software; and (5) organizing and implementing the program. *Computer Applications Planning* can be used as a reference manual or as part of a staff development program. This publication can be used in conjunction with training seminars, which are available within California through most of the Teacher Education and Computer (TEC) centers and outside California through the Merrimack Education Center, Chelmsford, Massachusetts. The seminars are designed to help district staff members develop a long-range plan for a curriculum-based comprehensive computer program (kindergarten through grade twelve).

The approach to computer education program planning embodied in this publication is curriculum based and focuses on how the curriculum can be improved by the use of computers. Staff training is allocated according to curriculum priorities, and hardware and software acquisitions are matched to application needs. The intended outcome of using this publication is a comprehensive program plan, including a philosophy and mission statement; statements of expected student competencies; identification of specific program starting points by subject area; and projections of staff training, hardware, and software requirements to implement the specific program components identified. Resource needs and budget projections are also developed for the long-range plan.

The purpose of this publication is not only to help users to find solutions but also to help practitioners develop their own responses to needs within their districts. Learning *why* something is needed is as important as deciding *what* is needed.

Computer Applications Planning, originally published by the Merrimack Education Center, Chelmsford, Massachusetts, is based on *Getting Started*, a publication of the Center for Learning Technologies, New York State Education Department. We especially thank Greg Benson, Director of the Center for Learning Technologies, for permission to use *Getting Started* and Richard Lavin, Executive Director of the Merrimack Education Center, for permission to adapt and publish this version of *Computer Applications Planning* for use in California schools.

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CHAPTER 1

Conducting Preliminary Planning Activities

Establishing the groundwork for comprehensive planning is nearly as important as the planning itself. This chapter describes the activities that need to be completed before planning begins. Five activities set the stage for the detailed curriculum development and organizational planning required to produce a comprehensive computer program. These activities are:

1. Forming the planning committee
2. Establishing broad direction
3. Designing and conducting orientation activities
4. Inventorying current computer applications
5. Identifying planning resource needs

Although these activities probably will be conducted in the sequence specified, some are repeated at several stages in the overall process. For example, orientation of school board members, parents, and members of community groups will need to be conducted continually.

ACTIVITY 1-A

Forming the Planning Committee

People who are affected by changes should be involved in planning them. Thus, involvement is the principal theme for preliminary planning activities. Three groups will be directly affected by implementing a computer program: staff members, students, and school board members. Those directing the planning effort should ensure that all three groups are included in the planning process. Other groups to include are parents and business and community representatives. Establishing a districtwide computer program planning committee can ensure adequate representation and qualified people for the work required. The computer program planning committee may be staffed in several ways, depending on the size and organization of the district.

Particularly in medium to large school districts, the planning committee should consist of a steering committee and a series of subcommittees. The steering committee serves as the decision-making group responsible for establishing policies and making recommendations for review by the superintendent and the school board. The subcommittees are responsible for developing material for the program plan.

Those directing the planning effort should consider the following suggestions when forming the planning committee:

- Include teachers and administrators from all levels (elementary, junior or middle, and high school) regardless of the focus of initial implementation activities.
- Include representatives of a cross-section of subject areas.
- Include students, parents, and business or community representatives on the committee. Solicit nominations from the school board or from already established groups, such as student councils, PTAs, and business and industry councils.
- Include some members who question introducing computers into the curriculum or make provisions to incorporate their input into the planning process.
- Include those with technological expertise but avoid having the committee viewed as a collection of computer experts.
- Organize the subcommittees according to the major task areas: curriculum, staff development, hardware and software, and organization and implementation.

Example 1-1, "The Planning Committee Structure," details a planning committee structure based on these suggestions.[1] In very small districts the superintendent should either serve as chairperson or appoint a building principal to direct the planning. In some

[1]Examples are numbered consecutively according to chapter and are grouped at the end of each chapter.

larger school districts, a computer program coordinator or director may have already been appointed. This position may be either full-time or part-time, depending on the program's scope and the district's resources. If a computer program coordinator is appointed, he or she should also serve as the planning committee chairperson. Example 1-2, "Sample Position Description: Computer Program Coordinator," contains a description of this position.

In order to represent all functional areas of the school district and to make the best use of personnel resources, the committee should organize itself into four functional subcommittees, which are coordinated by a steering committee. Subcommittee leaders should be appointed according to their areas of expertise as well as their existing job roles. For example, the person appointed to head the organization and implementation subcommittee should be experienced in curriculum development and computer technology. A building principal may be more qualified to head the staff development subcommittee, even though the curriculum director would normally fill that role. The committee chairperson should define the roles of each of the subcommittees, and a tentative schedule of meetings should be constructed. The steering committee should be composed of the committee chairperson; representatives of a cross section of subjects (Example 1-1 lists the curriculum director, special education director, Chapter 1 (ECIA) director, and the computer applications coordinator); the leaders of the subcommittees; a parent, a student, a business and community representative; and a school board member. These individuals should meet frequently to plan and coordinate the work of the subcommittees.

The size of the subcommittees should be determined by the amount of work to be done. Since subcommittee participation is only a minor, part-time responsibility for most faculty members, assignments should be kept small and manageable. The scope of work for these committees should cover the use and study of computers by students and teachers in the classroom and the use of computers to support teachers and administrators in managing instruction.

Although this publication deals primarily with instructional uses of the computer, those districts planning for administrative uses of the computer should form an additional subcommittee to deal with that specific topic. In some cases, such as computer-managed instruction, administrative applications are extensions of instructional ones. Most often, however, administrative applications are separate activities.

Once the planning committee is formed and subcommittees are appointed, the superintendent should give the members information that outlines specific objectives, tasks to be accomplished, and time lines. Example 1-3 details the three separate sections of the superintendent's work statement. Example 1-3A, "Letter to the Planning Committee," introduces the work statement and expected time lines; Example 1-3B, "Superintendent's Work Statement," contains the work statement itself; and Example 1-3C, "Topical Outline for a Computer Program Plan," further delineates the steps necessary in creating a districtwide computer instruction program.

ACTIVITY 1-B

Establishing Broad Direction

Before the entire committee first meets, the steering committee should meet to draft a statement of philosophy. This statement should set the direction of the work and address (1) the relationship of computer literacy (broadly defined) to the existing curriculum; (2) general student goals (sometimes referred to as the "mission"); and (3) guidelines for establishing the district's policy on such issues as equity, staff deployment (reassignments or creation of new roles), program priorities, and resource allocation. Example 1-4, "The Computer Education Program Statement of Philosophy," illustrates a draft statement of philosophy. *Computers in Education: Goals and Content* (California State Department of Education, 1985) as well as the Selected References at the end of this chapter also contain sources of additional statements of philosophy.

Although the statement of philosophy may be modified over time, the initial statement provides direction for subsequent planning. The statement should be reviewed by all committee members and then by the superintendent. Once general agreement on the statement is reached, the statement should be presented to the school board. (During the course of developing a districtwide computer instruction program, presenting the statement of philosophy to the school board should be just one of many presentations. Regular and frequent progress reports should be made to the school board because of the major impact that the completed plan is likely to have on the overall curriculum and on the allocation of staff, time, facilities, and money.)

A statement of philosophy provides the faculty members, the school board members, parents, and members of the community with a sense of what can be accomplished. Developing such a philosophy requires that the planning committee have an idea of what the future world of work and schooling will be

like. Based on these ideas, the philosophy forms the foundation for developing program goals and a set of strategies for achieving them. Once the philosophy statement is completed, it should be shared with all groups, and interested persons should be included in developing the program plan.

ACTIVITY 1-C

Designing and Conducting Orientation Sessions

Orientation sessions ensure that important groups have appropriate information with which to work. The planning committee should use Example 1-5, "Orientation Session Worksheet," to design orientation sessions. The planning committee should ensure that orientation is conducted for these three groups: (1) planning committee members; (2) administrators and teachers; and (3) school board members, parents, and members of the community. The content and format of the orientation should be adjusted to the needs of the group. This orientation should not be confused with the detailed training to be designed as part of the overall plan discussed in Chapter 3. At this stage the focus should be on developing awareness and general understanding. The following paragraphs contain information that should make designing and implementing orientation sessions easier.

The committee should consider the following suggestions when designing orientation sessions:

- Give early and special attention to building principals and other key administrators; they are essential to widespread acceptance and involvement of the teachers.
- Let faculty members conduct orientations whenever possible. Staff members have a good deal of expertise; using it builds credibility, lessens resistance, and can save money.
- Develop multiple ways of providing orientation. Consider printed materials or videotapes for individual or small-group review.
- Conduct orientation for planning committee members, teachers, and administrators first.
- Delay conducting orientation activities for other groups (school board members, parents, community members) until all preliminary activities are completed.

The following topics and related activities should be covered in the orientation sessions:

- *Present and future educational applications of technology.* Demonstrate a variety of applications in instruction, instructional management, and administration. Discuss trends in hardware and software development and possible implications for the future.
- *Courseware and general purpose software.* Demonstrate instructional software in a variety of subject areas and applications. Demonstrate popular software, such as word processing, spreadsheets, and database management programs.
- *Implications of computers and related learning technologies for curriculum, staff development, and organization.* Discuss the faculty's concerns, such as (1) replacing some teachers with computers; (2) redesigning the entire curriculum; (3) scheduling, planning, and implementing activities; and (4) ensuring that students have equal access to computers.
- *A technical overview of the computer.* Introduce computer components and describe their operation. Conduct a technical review of software.

The planning committee should also discuss how effectively the long-range districtwide program plan incorporates provisions for managing technological change. The chairperson should prepare a preliminary outline of the plan. This outline should be used to guide the committee's activities. Example 1-3B, "The Superintendent's Work Statement," should be modified to accommodate the committee's needs and preferences.

When discussing how to manage technological change, the committee should focus on the major barrier to successful program development and implementation—resistance—and formulate strategies for overcoming resistance.

ACTIVITY 1-D

Inventorying Current Computer Applications

To develop a comprehensive plan, the committee should be familiar with the computer applications currently in use in the district. At a minimum, descriptions of the hardware and software being used, the types of applications to be made, and the level of faculty computer competencies should be prepared. Examples 1-6 through 1-9, sample inventory and documentation forms, may be used to collect and organize the required information. Those districts wishing to plan for administrative applications should make an inventory of current uses at this stage.

This activity should be coordinated by the hardware and software subcommittee since the easiest way

to conduct such an inventory is to "follow the hardware." This information should be reported to the planning committee and updated frequently because hardward and software will continue to be purchased until the planning committee has completed its work. Information obtained from the inventory should be prepared as a status report and used as the basis for the long-range plan. The inventory should be viewed as preliminary and cursory. (More detailed inventories for hardware, software, and staff development are discussed in later sections.)

The hardware and software subcommittee should request this information from the district superintendent and should include a cover letter with the inventory forms. This letter should explain why the information is needed, how it will be used, and how it should be reported.

ACTIVITY 1-E

Identifying Planning Resource Needs

People are critical to the success of the planning effort, and their effectiveness is determined by the quantity and quality of resources they use to develop the plan. Typically, these resources fall into four categories:

1. *Information*
   a. Latest trends in technology
   b. Other school districts' programs
   c. Materials, programs, and practices available for review
   d. Latest research findings
2. *External experts*
   a. Specialized skills and knowledge needed
   b. Sources
   c. Costs
3. *Planning time*
   a. Meeting time required
   b. Time required for work sessions (individual and small group) and for preparing reports
4. *Materials:* reports, journals, and special publications needed

The committee chairperson and the directors of the subcommittees should prepare a preliminary list of resource requirements. This list should be reviewed by members of the subcommittees before it is submitted to the superintendent. Those preparing a preliminary list of resource requirements should make plans for procuring resources so that they will be available during the appropriate stages of the planning process.

CHAPTER 1 CHECKLIST

Preliminary Planning Activities

Before moving on to Chapter 2, "Integrating Computers into the Curriculum," persons conducting preliminary planning activities should be sure that:

- A planning committee has been formed. ☐
- Broad direction has been established by developing a philosophy statement and related policy statements regarding the computer program. ☐
- Orientation sessions for staff members, members of other key groups, and school board members have been designed and started. ☐
- An inventory of currently operating computer programs and activities has been taken. ☐
- Planning resource needs have been identified. ☐

While some of these activities may continue as other major steps are initiated, they should be started before moving on to curriculum and staff development.

SELECTED REFERENCES

Barger, Robert Newton. "Computer Literacy: Toward a Clearer Definition," *T.H.E. Journal*, Vol. 11 (October, 1983), 108—12.

*DeBevoise, Wynn. "Education and Technology: Predicting the Needs of the Future," *ERS School Research Forum* (May, 1983), 68—79.

Peters, G. David, and John M. Eddius. *A Planning Guide to Successful Computer Instruction*. Champaign, Ill.: Electronic Courseware Systems, Inc., 1981.

**Planning for Educational Technology*. Prepared by the Minnesota Department of Education. White Bear Lake: Minnesota Association of School Administrators, 1983.

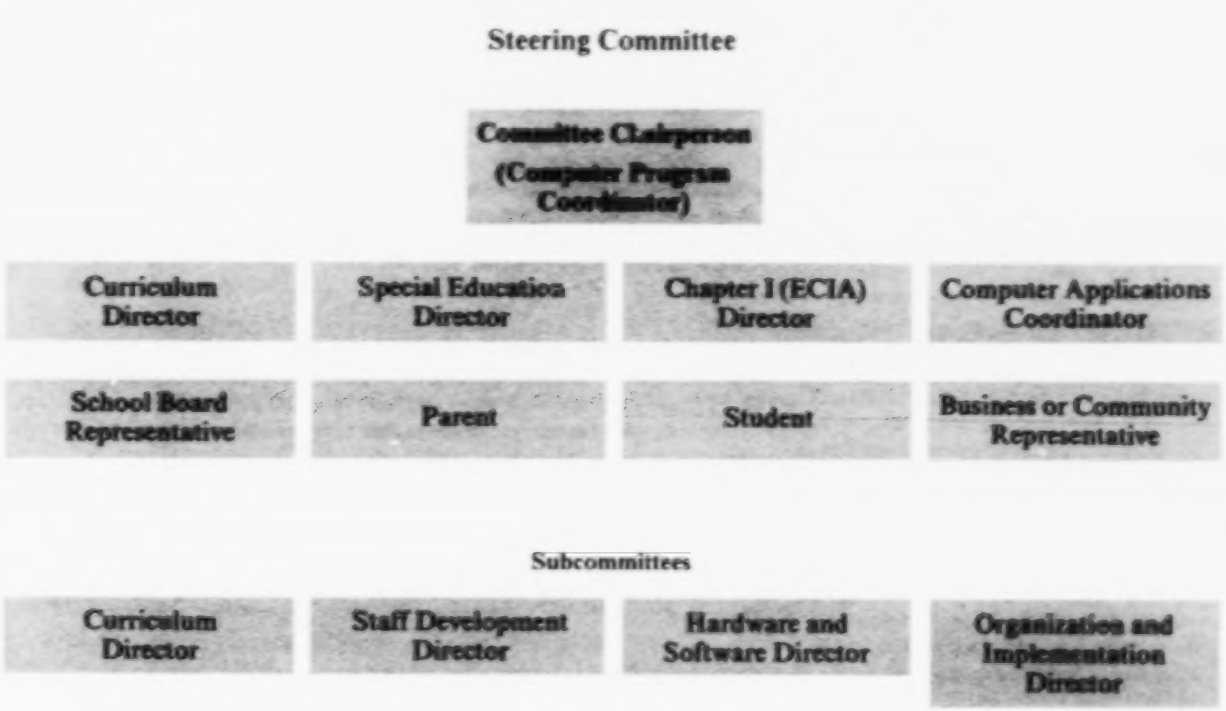
Steber, James M. "Developing an Effective Plan for Instructional Computing," *T.H.E. Journal*, Vol. 10 (April, 1983), 110-11, 114.

Technology Utilization Plan. Prepared by Independent School District #270, Hopkins, Minn.: Hopkins Technology Lighthouse, 1983.

*Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

EXAMPLE 1-1

The Planning Committee Structure



Usually, about eight to twelve principals or teachers per subcommittee are sufficient.

EXAMPLE 1-2

Sample Position Description: Computer Program Coordinator

Job Goal

To ensure the smooth and efficient operation of all computer applications, including hardware, software, training, and instruction for the school system. Computer application responsibilities are to be coordinated with the instructional goals of the school district through the assistant superintendent of schools.

Responsibilities

- Selecting and applying computer hardware as appropriate to the school district's needs
- Organizing a computer networking system within the school district
- Organizing programs to train teachers to use computers in the classroom
- Conducting training seminars, workshops, and institutes on hardware and software applications
- Assisting in the development of the kindergarten through grade twelve computer curriculum
- Providing technical assistance on computer applications to special departments, such as the business office, special education office, and guidance office
- Participating in systemwide computer advisory committees responsible for long-range planning
- Developing staffing plans for support and application of technology at various levels
- Developing student user groups and helping community members use computers
- Developing a systemwide software distribution plan and software exchange and selection system
- Updating computer plans and documents every six months

Qualifications

- A master's degree from an accredited college or university
- At least three years' successful teaching or program administration experience involving computers or both
- Experience in training or curriculum development or both
- Familiarity with current technology as it pertains to school applications
- Knowledge of hardware and software resources, vendors, and organizations
- Demonstrated success in accomplishing listed job responsibilities

Reports to

Assistant superintendent of schools

Terms of Employment

Twelve-month work year

EXAMPLE 1-3A

Letter to the Planning Committee

Dear Planning Committee Members:

We have been implementing a variety of computer instruction activities for some time. I believe we are now ready to initiate a comprehensive program, and our current activities have provided us with the experience needed to do so.

I am enclosing a work statement that outlines the steps necessary to produce a districtwide computer instruction program plan and a topical outline for the computer program plan itself. The work statement is imposing, I know, but anything less will not provide the kind of long-range program we need. I have promised the school board a comprehensive plan within four months. The plan will serve as the basis for our budget allocations during the coming year and provide us with program priorities over a three-year period.

I would like the chairperson and the subcommittee leaders to prepare monthly progress reports and submit them to me. I anticipate a productive effort and a valuable result. Thank you for your commitment to this most important work.

Cordially,

EXAMPLE 1-3B

Superintendent's Work Statement

Objective

To produce a three-year plan for the implementation of a comprehensive, districtwide computer instruction program

Major Questions to Be Addressed

- What will students need to know and be able to do?
- What grade levels and what subject areas will the program address initially?
- What competencies will teachers and administrators require in order to implement the program?
- How will they be helped to acquire these competencies?
- What effects will the computer program have on the existing curriculum?
- What new materials and equipment will need to be purchased?
- How will these materials and equipment be distributed, secured, and maintained?
- How will program priorities be phased in over the three-year period?
- What are the yearly and total program costs?
- How should the program be funded?

Tasks to Be Accomplished

Implement a computer curriculum that is integrated with the existing curriculum and specifies skills to be learned, criteria for evaluating progress, required instructional materials, and instructional management procedures.

Prepare a staff development plan that specifies what training and related development services teachers will receive and includes time lines and resource requirements.

Prepare a hardware and software procurement plan that is matched to the curriculum plan and includes recommendations on specific equipment and software and their costs over the three-year period.

Prepare an implementation plan that specifies how the program is to be phased in over the three-year period, what faculty and organizational changes will be required, and how the program will be monitored and modified.

Time Line

The superintendent will present the report to the school board in four months. The planning committee will submit a draft report to the superintendent within three and one-half months.

EXAMPLE 1-3C

Topical Outline for a Computer Program Plan

I. Introduction
   - A. Purpose of the plan
   - B. Background
   - C. Planning: process and people

II. Philosophy and Policies
   - A. Understandings and assumptions
   - B. Key concepts and principles
   - C. Policies

III. Program Mission
   - A. Goals
   - B. Student competencies

IV. Current Program Status
   - A. Applications
   - B. Staff competencies
   - C. Hardware
   - D. Software and support materials

V. Overview of Three-Year Plan (1985—1988)
   - A. Major program initiatives
   - B. Staging and phasing
   - C. Resource requirements
   - D. Budget

VI. Detailed Yearly Plans (1985-86, 1986-87, 1987-88)
   - A. Program initiatives and areas
   - B. Curriculum areas addressed
   - C. Staff development activities
   - D. Equipment requirements (existing and new)
   - E. Software and support materials requirements
   - F. Operations and implementation activities
   - G. Evaluation and follow-up
   - H. Costs and resource requirements

VII. Special Considerations

EXAMPLE 1-4

Computer Education Program Statement of Philosophy

Basic Principles

In developing and implementing a computer-based instruction program, educators should acknowledge the following:

- The most pressing need for educators continues to be the teaching of the basic skills—reading, communication, and mathematics. Without such skills, computer literacy is of limited value.
- Aside from the basic skills needed to use equipment and software, computer competencies should be integrated into the existing curriculum.
- Technology presents an opportunity to revitalize the existing curriculum, not merely automate it. The teaching of traditional basic skills should be augmented with "new" basic skills, such as problem solving, evaluating, analysis, and decision making.
- Students should use the computer to learn new skills and knowledge and to program special applications.
- To further their education and careers, students will need to use the computer to locate and manipulate information. Therefore, the curriculum should emphasize procedural as well as factual knowledge.

Program Priorities

As the goals in *Computers in Education: Goals and Content* suggest, program priorities should be set by philosophic preferences as well as by practical constraints of resources.[1] For example, a unified school district might decide initially to emphasize program development at the elementary level instead of the secondary level. The emphasis on one level does not mean that the other levels should be excluded from the program plan. The plan should provide for all students to be introduced to the computer during the first two to three years of the plan. The comprehensive program plan should specify the appropriate method of introduction.

The computer as a learning tool rather than as a teaching device should also be emphasized. For example, the use of such general applications as word processing, spreadsheet analysis, and database design and management should be emphasized over computer-assisted learning, electronic texts, or workbooks. Similarly, applications in which students decide the pace at which they will learn should be emphasized over applications in which the pace has been determined (drill and practice or workbook-type exercises).

Even though program priorities have been set and certain applications have been emphasized, existing applications should not be eliminated. Existing applications should be included in the new program.

Equity

An appropriate computer education curriculum should be prepared for all students in the district, kindergarten through grade twelve, and should be consis-

[1] *Computers in Education: Goals and Content.* Sacramento: California State Department of Education, 1985, p. 1.

EXAMPLE 1-4 (Continued)

Equity (Continued)	tent with sound educational practices. All students should be taught how to use a computer. However, the faculty members should determine what computer instruction is appropriate for each student within the context of his or her total learning program.
Staff Deployment	The computer program may require modification of existing roles. New specialists may have to be hired. Every staff member will need to acquire new competencies. In all activities students will have the best resources to accomplish the program's goals.

EXAMPLE 1-5

Orientation Session Worksheet

Session Checklist	Example
Target Group (Specify number, position, subject area.)	Thirty-seven teachers of mathematics, science, social studies, English, music, and the arts, grades seven through twelve
Objective	Teachers will understand how the computer can be used as a tool to conduct activities related to several subject areas.
Topics to Be Covered	Word processing, data storage and manipulation, information retrieval, graphics
Activities and Presentation Methods	Demonstrations of various computer tools; limited hands-on use of computers by participants
Equipment and Software Needed	Five microcomputers with large-screen monitors; several programs that have generic applications
Materials to Be Provided	Brief glossary of technical terms; descriptions of typical ways programs are used in classrooms
Time Required	Overhead projector and screen
Media Support	Two hours
Methods for Obtaining Feedback	Printed survey form; interviews with key informants; discussion session

EXAMPLE 1-6

Documentation of Current Computer Applications
(Needed for each application)

Subject Area

Grade

Teacher

Objectives

Hardware Required

Software Required

Special Student Populations

EXAMPLE 1-7

Inventory of Faculty Computer Competencies*

Determine the number and percent of faculty with the following competencies:

Number		*Percent*
_____	Can operate computer	_____
_____	Can locate and choose software	_____
_____	Can run software	_____
_____	Can evaluate software	_____
_____	Can develop instructional applications in which computers are used	_____
_____	Understands the specialized vocabulary that pertains to computers and their use	_____
_____	Understands the basic operations and capabilities of computers	_____
_____	Can use a shell (a program that has been modified for easier use), utilities, and authoring languages	_____
_____	Can write programs	_____
_____	Can develop courseware to use with microcomputers	_____
_____	Can teach programming, data processing, or word processing	_____
_____	Other _____	_____

*Adapted from *Curriculum Guide: Grades K—9.* Prepared by the Data Processing Joint Board (TIES). St. Paul, Minn.: St. Paul School District, 1982, p. 8. Used with permission.

EXAMPLE 1-8

Hardware Inventory Form

Computers

Type	Number	School and room number

Computer Peripherals*

Type	Number	School and room number

*Computer peripherals include printers, modems, disk drives, joy sticks, and so forth.

EXAMPLE 1-9

Software Inventory Form

Program name	*Instructional area*	*Type*	*School and room number*

CHAPTER 2

Integrating Computers in the Curriculum

A comprehensive curriculum for using computers should be integrated with the existing districtwide curriculum for the benefit of each.

Although the planning committee needs to consider many technical questions when planning for the integration of computers into the curriculum, educational decisions must be made before the technical questions can be addressed. Making educational decisions is best accomplished by a structured approach to curriculum development.

These five activities present a structured approach to developing the computer curriculum as part of the districtwide curriculum:

1. Developing broad goal statements
2. Developing student competency statements
3. Setting planning priorities
4. Developing curriculum objectives
5. Developing instructional strategies and applications

ACTIVITY 2-A

Developing Broad Goal Statements

A comprehensive curriculum for using computers is based on competencies students are expected to learn. These competencies should be translated into goals. *Computers in Education: Goals and Content* includes six strands for which student goals should be developed. These strands are (1) the operation of computer systems; (2) computer-assisted learning (CAL); (3) computer applications; (4) problem solving with computers; (5) computer science; and (6) the societal impact of computers.[1] Examples of general goal statements using the strands as categories might be:

- Students will have functional knowledge of keyboard skills, computer system components, operation of a computer, and various computer applications.
- Students will be able to use software designed for computer-assisted learning, such as drill and practice, tutorials, and similations, to acquire and reinforce learning in a variety of curricular areas.
- Students will acquire knowledge of procedural and nonprocedural languages and will be able to apply that knowledge to solve other curricular problems.
- Students will demonstrate knowledge of problem-solving skills in computer-related instruction and in other areas of the curriculum.
- Students will acquire technical skills and knowledge of various computer hardware and software.
- Students will be able to understand and make decisions based on ethics and values, the impact of computer technology, a history of computers and computing, technological consumer skills, and vocational and career information.

In the introduction of *Computer in the School: Tutor, Tool, Tutee,* Robert Taylor suggests that a computer can be used in three ways: (1) as a tutor in computer-assisted learning; (2) as a tutee in programming or otherwise instructing the computer to perform specific operations; and (3) as a tool—a word processor or a graphics device.[2] Goal statements that are based on Mr. Taylor's categories might look like this:

- Students will be able to use the computer as a teaching device to acquire knowledge and develop skills.
- Students will be able to instruct the computer to perform specific operations.

[1] *Computers in Education: Goals and Content.* Sacramento: California State Department of Education, 1985, p. 2.

[2] *Computer in the School: Tutor, Tool, Tutee.* Edited by Robert P. Taylor. New York: Teachers College Press, 1980, pp. 2—4.

- Students will be able to use the computer and available general-purpose software to compute and communicate.

In his article "Long-Range Planning for Computer Use," M. Tim Grady suggests the following goal statements:

- Each student will become aware of the use of computers and information technology in society.
- Each student will gain knowledge of computer-related terminology.
- Each student will acquire minimum competence in the use of computers and information technology.[3]

While these goal statements are sufficiently broad to include most expected outcomes, the curriculum subcommittee may modify them or include other statements.

The Selected References at the end of this chapter include sources of other goal statements. The curriculum subcommittee may review these sources, select those it believes would be most helpful, and take them to the total committee for review. Once goal statements are developed, they should be presented to the school board. In some cases the planning committee may have all teachers and administrators in the district review the goals before seeking school board approval. However, such a review may take considerable time to accomplish.

Goal statements become the curriculum's organizing framework. More specific student competency statements then should be developed for each of the goals.

ACTIVITY 2-B

Developing Student Competency Statements

The goal statements provide the curriculum's organizing framework, but the curriculum should contain specific student competencies. Although these statements are more specific, they are not yet linked to the existing subject-matter areas. Linkage will be accomplished in Activity 2-C, "Setting Planning Priorities."

The term *competencies* refers to knowledge and attitudes as well as skills. The competencies should specify what computer skills students will need in school and in their careers. Total agreement, even among experts, about what students should know does not exist; however, widespread agreement exists that students should know how to perform basic computer operations.

Expected student competencies dictate the required level of computer literacy. For example, Robert Taylor's first goal of computer use—to serve as a tutor—requires students to turn on the machine and "boot," or load, a disk. Mr. Taylor's third goal—to serve as a tool—requires students to set up files, prepare disks for data entry, or transfer and copy data. Students may need extensive keyboard knowledge as well as knowledge of the computer operating system in order to perform these tasks.

Example 2-1, "Sample Student Competency Statements," provides a selective sample of student competencies that are related to a specific goal. In addition to the competencies that require learning specific skills, students should also be instructed in the proper use of computers.

Once the curriculum subcommittee develops student competencies for each of the goals, the planning committee should determine appropriate grade levels. The planning committee should review sample computer curricula to determine how they fit within the district's present curriculum. The subcommittee should solicit advice from teachers and administrators before recommending the competencies to the planning committee.

For example, word processing could be introduced at the elementary school level; but the planning committee may decide that existing resources such as hardware, software, and trained staff dictate that word processing be introduced in grades eight through ten for all students and in grades six and seven for gifted students. Word processing may be introduced in the elementary grades as more teachers are trained.

ACTIVITY 2-C

Setting Planning Priorities

Because of limited time and resources, a complete curriculum cannot be developed and implemented in the first year. Before moving on to the detailed work, the planning committee should focus its limited time and energy on a subset of student competencies, grade levels, and subject areas. The philosophy statement previously developed should provide guidance on how to establish priorities. Example 1-4, the sample philosophy statement, emphasizes generic applications and presents criteria for making choices among competency areas, grade levels, subject areas, and applications.

[3]M. Tim Grady, "Long-Range Planning for Computer Use," *Educational Leadership*, Vol. 40 (May, 1983), 16.

Example 2-2, "Setting Priorities Among Competencies: Ratings," should be used to determine the initial focus of the planning committee's work. Since the planning committee selects priorities based on broad criteria, the committee should consider the following priorities and identify others that are important:

- *Student need.* How critical is the competency to successfully completing school or to a career?
- *Appropriate technology.* Are hardware and software capable of supporting the applications available in the district or from vendors?
- *Implementation.* Can the applications be implemented in a reasonable period of time?
- *Cost.* Is the expected cost of the application within the budget limits of the district? Do not close off options solely because they may require more resources than are presently available.
- *Staff readiness and commitment.* Are faculty members in one department, subject area, or grade level ready to move more quickly and with less training?

The steering committee should determine what criteria to use in setting priorities among the competencies and prepare a ranking form based on Example 2-2. Each competency or competency area, such as word processing, communication, or data processing, should be listed in the left column of the ranking form, together with the grade levels assigned by the committee.

The criteria to be used should be listed across the top of the form. Each competency then should be rated by each member of the committee on a scale of one to ten. A rating of one indicates a low priority and rating of ten indicates a high priority. Correlating a competency statement with an important student need produces a rating of eight or nine. However, if resources are not available, the rating falls to four or five.

If the committee members decide that the criteria are not of equal importance, each criterion should be assigned a weight according to its relative importance. For example, if the committee members feel that first-year staff readiness is very important, that criterion should receive a higher weight. If the criteria are also ranked, that should be done before ranking the competencies.

In Example 2-3, "Setting Priorities Among Competencies: Rankings," the criteria are assigned weights on a scale of one to five. For example, student need is weighted three, while staff readiness is weighted five. The relative weights indicate that the committee considers student need less important during the first year than the availability of trained teachers.

Next, each competency statement is rated on a ten-point scale for each need. Cost is rated eight, indicating that the costs are reasonable or acceptable. Staff readiness is rated seven, indicating that the staff members are generally ready to address the competency. Appropriate technology is rated eight, indicating that the hardware and software are available to support the application.

Student competencies and competency areas will be listed in order of importance by completing the ranking forms based on examples 2-2 and 2-3. Areas at or near the bottom of the list should not be eliminated. They should be postponed until additional resources are available. The planning committee should use the ranking as a guide to develop the overall management plan and to prepare recommendations for future programs.

Setting priorities for program development over the three-to-five-year period addressed by the plan does not mean that existing activities should be ignored. The committee should examine applications already in place and determine how they can be supported and incorporated into the program plan. Often, the efforts of an individual or small group of teachers form the foundation for a comprehensive program. Building on such a foundation can usually be accomplished more quickly and efficiently, often without the resistance that accompanies totally new programs.

In summary, setting priorities should be structured to allow for a systematic application of criteria to all competencies. Such a process should be complemented and supplemented by professional, sometimes intuitive, judgments about what will work. Knowledge of current practices and of the dynamics of change in the district are essential factors in the decision process. The process of setting priorities should help the committee identify and deal with such issues as equity, limited resources, and needed organizational changes.

ACTIVITY 2-D

Developing Curriculum Objectives

Student computer competencies should be incorporated into the existing curriculum during the development of curriculum objectives. The curriculum subcommittee should assign each competency to one or

more subject-matter areas and should specify the computer application to be made in that subject area. For example, the curriculum subcommittee may decide to assign word-processing competencies to the English and language arts area. Such an assignment would give teachers in that area primary responsibility for teaching word processing. How the teaching of word processing should be accomplished is not specified at this point; guidelines to develop instructional strategies and applications are outlined in Activity 2-E, "Developing Instructional Strategies and Applications."

The English and language arts department may be assigned to teach word-processing skills. However, some members of the subcommittee may want to have general word-processing skills developed in a typing class and leave only subject-matter applications to the English and language arts department. In some cases, assigning competencies to one specific subject area may be difficult, and two or more subject areas may be selected. For example, competencies related to the use of graphics programs may be taught in mathematics or art. When several areas are involved, the subcommittee should ensure that instructional planning avoids unnecessary duplication and encourages coordination in developing basic computing skills.

Integrating computer competencies into the existing curriculum is a major undertaking. Existing objectives may need to be modified, and new ones may need to be developed. During this process, the subcommittee should note areas in the curriculum that need further examination or development, although making major changes is not the subcommittee's primary task.

Example 2-4, "Computer Curriculum Objectives," includes computer competencies that have been translated into curriculum objectives. The objectives integrate the computer competency with traditional skills covered in the existing curriculum. In some cases, the availability of computers necessitates modifying or adding new objectives.

The scope and level of detail of curriculum development activities (the completion of activities 2-D and 2-E) will depend on the time and other resources available. During the first year the subcommittee may only develop curriculum objectives and detailed instructional applications in one or two subject-matter areas. The plan itself may contain only one or two complete program units or modules, serving as an example to the school board of what could be accomplished with additional training and time. The program plan may only indicate general curriculum areas to be phased in during the three-year period.

ACTIVITY 2-E

Developing Instructional Strategies and Applications

In this activity instructional objectives, methods, and performance assessment measures should be specified. This step naturally follows the development of broader curriculum objectives but should not be undertaken until the faculty members who are responsible for implementing the instructional plan have completed staff development training. This level of curriculum planning should be conducted by the respective subject-matter and grade-level teachers. The curriculum subcommittee may serve as the coordinating body, but the subcommittee may need to expand and separate into teaching teams organized by grade level or subject matter.

Detailed instructional development should be considered a legitimate and necessary part of the overall staff development program. Although the development of instructional strategies and applications is covered in this section, instructional strategies and applications are also considered during staff development and hardware and software selection. (Staff development is covered in Chapter 3, and hardware and software selection is covered in Chapter 4.)

Although the overall program plannning process flows in a sequential loop, the process does not always move forward; it is often necessary to return to a previous step. Thus, curriculum development occurs before and follows after staff development. A broad level of curriculum development is needed to train staff members, and specific curricula cannot be developed without staff training.

The development of instructional strategies and applications involves the determination of the expected, specific student competency; the instructional approaches or methods to be used; the materials and equipment required; and the methods for assessing student performance. Example 2-5, "Instructional Applications," illustrates instructional objectives and includes descriptions of suggested instructional methods and materials and assessment measures. For each curriculum objective, several instructional applications may exist.

Although developing curriculum objectives and instructional applications is a difficult and time-consuming process, many resources are available. (Several are cited in the Selected References at the end of this chapter.) Teachers engaged in instructional planning should select curriculum and instructional objectives after reviewing entire instructional applica-

tions and lesson plans. Teachers will still need training in the developmental process, but to save time, they should modify the curriculum and instructional objectives they have selected rather than develop new ones.

Integrating computers into the curriculum is an ongoing task that requires the efforts of all faculty members. The planning committee should establish a curriculum framework and begin detailed instructional planning. The faculty members, however, should complete the detailed instructional planning. Thus, the cycle of curriculum development/staff development/instructional development will be repeated at regular intervals throughout the multiyear computer program implementation.

CHAPTER 2 CHECKLIST

Integrating Computers in the Curriculum

Before moving on to Chapter 3, "Delivering Staff Development Services," the curriculum subcommittee should be sure that:

- Broad goal statements have been developed. ☐
- Student competency statements have been developed. ☐
- Planning priorities have been set. ☐
- Curriculum objectives have been developed. ☐
- Instructional strategies and applications have been developed. ☐

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*Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

EXAMPLE 2-1

Sample Student Competency Statements

Goal

Students will be able to use the computer and appropriate software to compute and communicate.

Competencies

- Students will understand how computers are used to communicate and perform computations in various occupations.
- Students will understand inappropriate uses of the computer.
- Students will know the computer keyboard layout and the functions of special keys.
- Students will know how to perform general purpose operations, such as file and disk copying and related maintenance operations.
- Students will be able to select and use an appropriate software program for graphing data.
- Students will be able to select and use an appropriate word-processing program for preparing written reports and papers.
- Students will be able to access and search on-line automated information files.
- Students will be able to select and use appropriate software for manipulating data for synthesis, analysis, and projections.

EXAMPLE 2-2

Setting Priorities Among Competencies: Ratings

Students will be able to use the LOGO programming language to illustrate basic mathematical concepts and operations.					
Grade four Ratings (10 = high/ 1 = low)	8	7	7	8	30
Students will be able to use a computer and related peripherals to conduct scientific observations.					
Grades seven to nine Ratings (10 = high/ 1 = low)	5	3	2	8	18
Students will be able to select and use an appropriate word-processing program for preparing written reports and papers.					
Grade nine Ratings (10 = high/ 1 = low)	6	4	4	7	21

EXAMPLE 2-3

Setting Priorities Among Competencies: Rankings

Competencies and grade level	*Criteria*				
	Student need	*Cost*	*Staff readiness*	*Appropriate technology*	*Total*
Weight (5 = high/1 = low)	3	4	5	3	
Students will be able to use the LOGO programming language to illustrate basic mathematical concepts and operations.					
Grade four Ranking (Rating × Weight)	8(24)	7(28)	7(35)	8(24)	111
Students will be able to use a computer and related peripherals to conduct scientific observations.					
Grades seven to nine Ranking (Rating × Weight)	5(15)	3(12)	2(10)	8(24)	61
Students will be able to select and use an appropriate word-processing program for preparing written reports and papers.					
Grade nine Ranking (Rating × Weight)	6(18)	4(16)	4(20)	7(21)	75

EXAMPLE 2-4

Computer Curriculum Objectives

English/Language Arts	Students will be able to use a word-processing program to prepare a research report, including footnotes and a bibliography. Students will be able to use appropriate software to identify and correct spelling errors in their written work.
Mathematics	Students will be able to use the LOGO programming language to calculate and plot various geometric forms. Students will be able to use courseware to learn and apply algebraic operations.
Science	Students will be able to use courseware to observe and analyze chemical and physical changes in various substances. Students will be able to plot data from experiments and develop graphs and other visual representations.
Social Studies	Students will be able to use graphics software to prepare charts and graphs illustrating various characteristics of society. Students will be able to access on-line databases, such as newspapers and encyclopedias, and conduct research on selected topics.
Art	Students will be able to use the LOGO programming language to develop and combine the basic forms. Students will use courseware to learn to mix colors.

EXAMPLE 2-5

Instructional Applications

Curriculum Objectives	1.0 Students will be able to use a word-processing program to prepare a research report, including footnotes and a bibliography. 2.0 Students will be able to access on-line databases.
Instructional Objectives	1.1 Students will use a word-processing program to set margins, tabs, and line spacing; to move paragraphs; and to edit text. 2.1 Students will use a modem and appropriate communications software to connect with on-line encyclopedias.
Instructional Methods	1.2 Demonstration of word-processing software operations; hands-on use by students 2.2 Demonstration of techniques for searching an on-line encyclopedia
Instructional Materials/Equipment	1.3 Word-processing software and instructional manuals Computer lab with no more than three students per computer A large-screen monitor for demonstrating to the entire class 2.3 Modem and communications software Large-screen monitor for viewing by the entire class Handouts describing steps in connecting to a database and describing searching techniques
Assessment Measures	1.4 Students will prepare a one-page essay in which margins, tabs, and spacing are set as required. Students will demonstrate the ability to move paragraphs. 2.4 Students will access a specific on-line database and obtain information through appropriate searching techniques.

CHAPTER 3

Delivering Staff Development Services

Because time and money are limited, all staff members may not be trained during the first year or two.

However, once priorities among competencies and objectives are set, teachers who require immediate training and support should be identified. Just as the implementation of the computer program can be designed in spite of limited time and money, so can staff development services be delivered over several years, according to implementation priorities established for the curriculum. The term *staff development* includes not just training sessions but the whole range of activities used to help faculty members and administrators develop new knowledge, attitudes, and skills.

The following activities are included in staff development:

1. Identifying required competencies for the faculty
2. Determining actual competencies for the faculty
3. Establishing a staff development program

ACTIVITY 3-A

Identifying Required Faculty Competencies

Once curriculum priorities are established, the staff development subcommittee easily can identify faculty competencies required to design and implement instruction. Example 3-1, "Required Competencies for the Faculty," may be used to design a form on which to organize the required information. In some instances teachers or principals should possess knowledge or skills beyond those they need to impart to students. For example, teachers may need to know how to use a computer networking system in a laboratory or how to use specific functions of the computer operating system. These special requirements should be specified on the form.

ACTIVITY 3-B

Determining Actual Faculty Competencies

Once teachers and principals who require staff development services have been identified, the skills and knowledge they already possess in the specific competency areas should be identified. Identifying these skills is important because teachers and principals should not be trained if they already possess sufficient skills, and some teachers and principals may have advanced skills and knowledge and can serve as team trainers, facilitators, and expert partners.

Testing or otherwise formally assessing teachers' competencies is not necessary. Such practices are costly, time-consuming, and intimidating. Instead, a self-assessment form should be used to collect the required information. Example 3-2, "Staff Computer Competency Inventory," is designed to be used by high school science teachers and should be modified for other subjects. Not only does Example 3-2 allow teachers to judge their own proficiencies and needs, the specific competencies they will be expected to master are listed. Self-assessments typically contain considerable unmeasurable errors, but since the competencies are so well defined in Example 3-2, teachers should not misjudge or misrepresent their abilities.

Because of the critical role principals and other administrative staff members have in supporting the instructional process, their competencies should also be determined. Administrators may not need to have detailed knowledge of particular computer operations or software, but their understanding of broad curriculum issues and program organization and implementation requirements is essential.

ACTIVITY 3-C

Establishing a Staff Development Program

The staff development subcommittee should design the staff development program once the required and actual faculty competencies have been determined. Teachers and principals who need or wish to develop or improve their skills and knowledge in each competency should be identified. Analysis of the data collected from Example 3-2, "Staff Computer Competency Inventory," should provide the required information.

After analyzing the data, the competencies—knowledge, skills, and attitudes—should be organized in levels that can be covered in a training session or in reading materials. Example 1-7, "Inventory of Faculty Computer Competencies," provides a list of competencies that may be useful. Example 3-3, "Organizing Competencies," illustrates how specific competencies may be organized according to levels.

A syllabus and agenda for the training sessions should be prepared for each level based on Example 3-3. Example 3-4, "Sample Course Syllabus," is a Level I course syllabus used by the Merrimack Education Center.

For each course, a training module, outline, or a lesson plan that details instructional methods, materials, and activities should be prepared. Example 3-5, "Sample Training Session Module Outline," provides a framework for preparing a training module.

Training sessions may be the most efficient means for providing faculty members with new knowledge and skills. However, the staff development subcommittee should also consider using the following strategies and activities:

- Reading for self-study
- Teaming inexperienced teachers with more experienced colleagues
- Observing exemplary computer applications in other schools or districts
- Conducting individual or small-group work sessions to develop materials or instructional methods

In addition to designing the training program, the staff development subcommittee should stage and phase training activities over the three-to-five-year period. This sequencing should parallel the projected implementation of major program initiatives. Assigning costs to the staff development component will be easier if staff competencies and members who will be trained are identified.

Studies of the implementation of new programs and practices attest to the importance of comprehensive and effective staff development. The staff development subcommittee should consider the following suggestions when planning activities:

- Design a long-range program. Aside from the intrinsic benefits, a long-range program indicates that staff development is a district priority.
- Involve principals in staff development activities. Research and experience testify to the importance of principals' involvement and leadership in major educational changes.
- Consider the following principles to enhance computer competency training:
  1. In-service training should prepare the faculty members to perform tasks and also provide criteria for determining their degree of success.
  2. Training activities should be organized in a sequence that gradually increases in complexity.
  3. The training should be sufficiently flexible to allow trainees to begin at their own level of ability and progress at their own rate.
  4. Training should take place during the school day and make use of actual teaching situations.
  5. The training should be adjusted to the existing instructional setting.
  6. Incentives should motivate faculty members to participate actively.
  7. Whenever possible, district or school faculty members should be used as instructors.
  8. Teachers should have an opportunity to practice new skills in the course of their regular teaching.
  9. Skills acquired in a training program will not be used if they are not valued by school administrators.
  10. The faculty members involved in a training program should have continuous access to a facilitator—a trained technical resource person.
- Expect skepticism and resistance from some faculty members (it is natural) and make provisions for dealing with it openly and directly.[1]

When preparing the staff development plan, the staff development subcommittee should estimate costs over the three-to-five-year period. These estimates are important because the amount and cost of training and other staff development activities are often grossly underestimated, particularly for developing skills beyond basic hardware and software competencies. The com-

[1]Adapted from *Getting Started.* Prepared by the Center for Learning Technologies. Albany: New York State Education Department, 1983, p. 13. Used with permission.

mittee should also consider the following when preparing cost estimates:

- Establishing accurate yearly cost projections may be difficult, particularly for a long-range plan. A specific and accurate estimate should be prepared at least for the first year.
- Using percentages of the total computer program budget as estimates of training costs is likely to result in inaccuracies unless initial figures are based on experience.
- Projecting training costs should be relatively easy if the program initiatives to be implemented each year have been identified. The three basic steps are as follows:
  1. Determine the number of teachers who will implement each program initiative (major computer curriculum unit or module).
  2. Determine the cost per unit of obtaining the training required and multiply the amount by the number of staff members who will implement the program unit.
  3. Add the cost estimates for any of these applicable expenditure categories: teacher stipends, substitute teachers, materials, and facilities.

The five major ways of procuring training and other staff development services not already available through existing district resources and the costs, advantages, and disadvantages associated with each are shown in the following list:

1. *Hardware vendor*
   a. Training is machine-specific.
   b. Training is primarily technical.
   c. Training may be expensive.
   d. Donated training may be available in conjunction with donated hardware.
2. *Teacher Education and Computer (TEC) centers*
   a. Fifteen regionally based centers serve one or more counties.
   b. Hardware and software information and training are available at the centers.
   c. Most TEC centers offer a range of training responsive to the needs and interest of teachers in the region.
   d. Costs are usually reasonable.
3. *TEC sponsored on-site training*
   a. TEC center trainers use local equipment, facilities, and often use local teachers.
   b. Training sessions can be tailored to local needs of teachers and administrators.
   c. On-site training costs may be less than training at the TEC centers if on-site equipment is adequate.
4. *Private consultants*
   a. Experts provide services using local district's equipment and facilities.
   b. On-site training can be tailored to local needs.
   c. Long term, follow-up assistance may not be available.
   d. Costs vary considerably; they may range from $100 to $300 per day.
5. *Institutions of higher education*
   a. These include California Community Colleges; California State University (CSU) and University of California (UC) campuses; and private colleges and universities.
   b. A variety of courses and programs may be offered, including formal college courses for which participants pay usual fees.
   c. Teacher salary credits may be available.
   d. Summer institutes may be offered.

Whatever training sources are used, only a select number of district staff members should be trained. They then should act as trainers for the rest of the faculty—a "trainer of trainers" model. This can reduce costs considerably. However, the trained staff members must be available to serve as trainers and may require training beyond those activities provided in the basic course.

Staff development and curriculum development are recurring activities, each dependent on the other. While staff members may need help in acquiring basic computing knowledge and skills, subsequent stages of training should focus on specific competencies related to the curriculum.

CHAPTER 3 CHECKLIST

Delivering Staff Development Services

Before moving on to Chapter 4, "Acquiring Hardware and Software," the staff development subcommittee should be sure that:

The competencies needed by teachers and administrators to implement the curriculum have been identified. ☐

The specific knowledge and skills possessed by the teachers and administrators have been determined. ☐

A comprehensive staff development program has been established. ☐

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*Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

EXAMPLE 3-1

Required Competencies for the Faculty

Students will be able to use commercial software to simulate experiments and natural phenomena.	Basic systems operations	12	9	Science
Students will be able to use a computer and peripheral instruments to monitor scientific experiments and collect data.	Use of plug-in boards and measurement probes	10	10—12	Science
Students will be able to use a computer to analyze and plot data from scientific experiments.	Use of graphics software and printers and plotters	10	10—12	Science
Students will be able to develop computer programs to perform special functions, such as evaluating data and preparing formulas and models.	Use of Pascal programming language	5	11—12	Science

EXAMPLE 3-2

Staff Computer Competency Inventory

Name _____

School _____ Grade _____

Subject area _____

The computer curriculum planning committee has proposed that computers be included in the high school science curriculum.

Please complete this questionnaire to help determine subjects to be taught in the staff development program.

For the four competency areas, circle the numbers that best describe your competency level and indicate by writing either *yes* or *no* whether you wish more training.

Competency	*Competency level*					*More training?*	
	High		*Medium*		*Low*	*Yes*	*No*
Can use a computer to run software which simulates various scientific experiments and phenomenon	5	4	3	2	1	____	____
Can use a computer and related peripheral instruments to monitor scientific experiments and collect data	5	4	3	2	1	____	____
Can use a computer to analyze and plot data from scientific experiments	5	4	3	2	1	____	____
Can program a computer to perform special functions, such as evaluating data and preparing formulas and models	5	4	3	2	1	____	____

EXAMPLE 3-3

Organizing Competencies (An Abbreviated List)

Level I
Basic Awareness

1. Can operate computer
   - Knows major parts of computer system
   - Is able to use disk drives and printers
   - Can use keyboard
2. Can choose software
   - Knows sources of courseware information
   - Can match software to applications

Level II
Curriculum Awareness

3. Can evaluate software
   - Can apply selection and evaluation criteria
   - Can determine relative effectiveness and appropriateness of software
4. Understands basic computer operations and capabilities
   - Knows the functions of common operating systems
   - Can perform basic disk and file management operations

Level III
Technological Awareness

5. Can use authoring languages or packages
   - Can prepare instructional specifications
   - Can use authoring programs to create simple drill and practice routines
6. Can write programs
   - Is able to use high-level programming languages
   - Can translate instructional design specifications into computer code

EXAMPLE 3-4

Sample Course Syllabus

Course Name

COMPUTER LITERACY

Overview

This introductory three-day course is conducted in 12 sessions and provides basic information about computers, courseware, and classroom applications and training in using computers for teaching and management. The course is intended for teachers and administrators who have little or no previous knowledge or experience with computers. Typically, a class is composed of educators from one school district, but educators from several districts can participate.

Objectives

At the completion of the course, participants will be able to:

- Identify the distinguishing features of the most popular microcomputers.
- Select computer hardware (for microcomputers and minicomputers) appropriate for particular courseware and classroom applications.
- Perform basic system operations on at least two computers.
- Develop and use criteria for the selection and evaluation of courseware.
- Develop specific applications of computers for classroom use.
- Design strategies for the implementation of computer-based education.

Outline of Sessions

Schedule	*Topic*	*Activities*
First Day		
Session 1.1	Introduction Initial computer experiences	Hands-on experience with microcomputer and minicomputer
Session 1.2	Computer competencies: history and training	Lecture and discussion
Session 1.3	Classifying computer-assisted learning (CAL) software	Demonstration and hands-on experience
Second day		
Session 2.1	Hardware systems	Demonstration
Session 2.2	Software review	Examination of selected commercial courseware
Session 2.3	Classroom applications	Panel and group discussions of successful practices
Third day		
Session 3.1	Classroom applications	Design of instructional applications by small groups
Session 3.2	Implementation strategies	Group work on strategies

EXAMPLE 3-5

Sample Training Session Module Outline

Specific Competencies (knowledge, skills, attitudes)	• Understands how to use the Apple II with educational applications • Understands how a microcomputer works and can operate one without assistance • Uses a microcomputer for classroom instruction and talks to others about how it can be used for instruction
Topics	• How a microcomputer processes data • How to run programs • How to care for and handle diskettes • How to locate and review available software
Related Activities	• Lecture and demonstration • Hands-on activities
Equipment	• Ten Apple II's with single drives and color monitors, with necessary extension cords and power strips • Overhead projector
Materials	• Minnesota Educational Computing Consortium (MECC) training materials: "Introduction to the Apple II in Instruction" (handouts) • Transparencies • MECC Apple Demonstration Disk (with documentation) • MECC Apple II User Guide • Selected commercial software
Feedback and Evaluation	• Standard Merrimack Training Evaluation Form

CHAPTER 4

Acquiring Hardware and Software

The software and hardware acquisition process can be broken down into three activities:

1. Establishing a selection criteria and process for acquiring software
2. Establishing a selection criteria and process for acquiring hardware
3. Preparing procurement specifications

Because most school districts already have some software and computers, planning for future acquisitions should be based on availability as well as need. The major difference between this process and the process used by most districts is that this process is based on a detailed curriculum plan. Thus, the process of software and hardware selection begins where instructional planning ends. The process of software selection is a natural extension of instructional planning and involves determining what instructional materials will be required to accomplish curriculum goals and objectives.

ACTIVITY 4-A

Establishing the Selection Criteria and Process: Acquiring Software

Selecting software is a four-step process: (1) identification; (2) description; (3) application; and (4) evaluation. Software should be selected before hardware because most software is not compatible with all popular microcomputers. While compatibility may not be a problem in the future, most high quality software now runs on only three or four of the most popular microcomputers. When some hardware is already available in the district, the software choices may be constrained until additional hardware can be purchased.

Districts that have purchased inexpensive microcomputers to teach basic literacy skills may find that their equipment cannot run more complex software. Districts should allocate hardware with different capabilities to different purposes. More limited equipment should be used for introductory skills, and more powerful computers should be used for advanced skills or instructional applications. By beginning with present and anticipated software needs, districts can minimize this problem.

The first task of the hardware and software subcommittee is to develop a list of software needed for anticipated instructional applications. (An example for this step is not provided.) The rapid increase in the amount of software available makes this step difficult. Many sources of software information exist; Appendix B, "Software for Educators," lists several.

The subcommittee should screen the list of software once it is completed. Example 4-1, "Software Documentation Checklist," details areas to investigate. A document helpful to the screening process may be "Guidelines for Educational Software in California Schools" (Educational Technology Unit, California State Department of Education). This document is available at the TEC centers. Other information required to screen software should be available from reviews in journals or other descriptive material. It may be necessary to run the software in order to respond to some of the items in Example 4-1, such as items seven and nine. As the software collection grows, this descriptive information can be catalogued in a computerized file for easy selection.

Once basic software documentation is obtained, the subcommittee should determine if the software meets the established instructional objectives. Typically, these questions are included in the evaluation, but they are not actual judgments of software quality. Instead, they are judgments about the appropriateness of the software for a particular instructional application, regardless of its technical quality or "application criteria."

Completing the Example 4-2, "Applications Criteria Checklist," is the third step in the process of select-

ing software for classroom use. This form will be useful to classroom teachers during the selection process. Teachers can use the form to assess how well the software complements ongoing classroom instruction. Completing examples 4-1 and 4-2 should make judging software quality easier.

Example 4-3, "Software Evaluation Criteria Checklist," contains questions to use in accomplishing the final step of the software selection process. While some may be answered with a yes or no response, most will require some form of rating scale.

Members of the subcommittee should keep in mind that software and the supporting printed materials are essentially instructional materials and that the basic principles used to evaluate textbooks and other educational materials apply. Therefore, reviewing curriculum standards and guidelines published by professional associations or state educational agencies may be necessary.

Forms for evaluating software have multiplied as rapidly as the interest of teachers and administrators in computer-based education. How many of these criteria are actually used depends on the time and resources available for assessment, the cost of the software, and the scope of its use—whether used in one classroom or districtwide. When using cost as a criteria for software selection, the "Suggested District Policy on Software Copyright" developed by the International Council for Computers in Education (ICCE) should be reviewed. A copy of this suggested district policy has been distributed to all school districts and offices of county superintendents of schools.

The software package should not be rejected because of poor ratings on any one or two criteria. Because improved software is being developed continually, most software presently available may not be able to meet all or most of the listed criteria. Judgments should be made on whether the inadequacies can be overcome through software modification or through other means of instruction.

Teachers will not have sufficient time to use these criteria and procedures to evaluate and select all software that they will use (although a districtwide committee may). It is more likely that much of the technical screening of software according to criteria found in Example 4-2 will be accomplished through formal evaluations conducted by special-purpose organizations. (Examples of such organizations are contained in Appendix D, "Professional Organizations and User Groups.")

Finally, all the software to be purchased cannot be specified in the program plan. The curriculum, including the specification of instructional applications, must be completed before software purchases can be made. The plan should include a brief description of the selection process and rough estimates of the kind and cost of software needed to implement the first major program initiatives.

ACTIVITY 4-B

Establishing the Selection Criteria and Process: Acquiring Hardware

Once appropriate software is selected for each instructional application, compatible computer hardware should be chosen. In "A Decision Model for Microcomputer Applications," Robert Tinker suggests a five-step process for each instructional application:

1. Estimate how much time a student will need on the computer in order to accomplish the objectives.
2. Determine how many students can use the computer simultaneously. Can students work in teams of two or three to a machine?
3. Determine what computer capabilities are required to run the courseware you intend to use: size of memory, type of data storage, color.
4. Identify the available hardware systems that have those capabilities.
5. Rate each system on such criteria as:
   a. Range of software it will run
   b. Its frequency of repair record
   c. Available service and technical support
   d. Potential for expansion
   e. Ease of use
   f. Range of high-level languages (BASIC, Pascal) it will run[1]

The following six recommendations supplement Mr. Tinker's:

1. Define specifically the intended application: "The computer system is to utilize software providing color, sound, and visual response in mathematics and drill and practice in language arts."
2. Define who the users will be: "The computer system will be utilized, under the supervision of the classroom instructor, by third through fifth graders at the Montgomery School."
3. State where the computers will be used: "The computer system will be secured to a mobile cart

[1]See Adeline Naiman, *Microcomputers in Education: An Introduction.* Chelmsford, Mass.: Northwest Regional Exchange, 1982, pp. 45—49. Used with permission.

and transported to each classroom in which it will be used."

4. Indicate when the computers will be used: "The computers will be used in the school media centers throughout the school day and for one-half hour before and after school."
5. Indicate why the computer will be used: "This system is provided to classroom instructors as a tool to help reinforce basic mathematics and language skills as well as to provide a hands-on experience for the students with technological products they will use as adults."

Some of the features of computer systems that can be used as criteria in the selection process are:

- *Processor.* The type of CPU (central processing unit) "chip" determines processor flexibility. Chips on which standard operating systems such as CP/M (Control Program for Microcomputers) can be run provide more flexibility and future compatibility. Popular CPU's include the 8080, Z-80, and 8086, all capable of running CP/M. Another popular chip is the 6502, which is used in several computer systems.
- *Internal memory.* The maximum amount of memory in the form of RAM (random-access memory) determines the level of software sophistication and student usability. Most software products provide the minimum amount of memory required, measured in kilobytes, K or Kb. Typical memory sizes range from 16K to 128K.
- *Mass storage.* The capacity of mass storage devices, such as floppy disks, determine the number of disk drives required as well as the system's total cost. Also measured in kilobytes, the typical 5¼-inch drives range between 125K to 450K of storage.
- *Editing keys.* If working with on-screen data, editing keys should be considered. This feature varies widely, ranging from none on one of the most popular computers to full cursor control for all four directions, plus insert, delete, and screen editing capabilities on another model.
- *Numeric keypad.* Important where numbers will be in constant use, such as mathematics and financial applications, this additional keyboard is usually attached to the main keyboard and arranged in a format found on calculators.
- *Touch.* Totally subjective, touch describes the feel of the keyboard. The keyboard on the IBM Selectric typewriter is the most widely accepted standard.
- *Display width.* Display width is a consideration in computer literacy applications involving business (accounting, word processing, and so forth). The standard display width for 8½-inch by 11-inch paper is 80 columns.
- *Appearance.* Too often downplayed, many of the available microcomptuers are unattractive and tiring to work on, and the operators and working environment suffer because of it.
- *Price.* Price is a significant factor, but it is not the most important one. When balanced against available features, some computers will be dropped for lack of competitive value.

Many more specific criteria can be employed when selecting hardware. The supplementary readings and Appendix A, "Selected Periodicals," contain information on other sources. In most cases selecting hardware involves considerable compromise, since any one computer model is not likely to have all desired features at an affordable price.

More than one computer model may be used throughout the district, although over time this may not be the case. However, hardware must be matched with the various applications it will be expected to perform. Consequently, total standardization may not be desirable. Many districts will have already acquired one or more models through donations, federal funds, and so forth. (Purchasing additional models of a computer because it is known and available is not recommended; features needed to implement the program should also be considered.) Students should be exposed to a range of equipment as they work on different applications. Students must be able to adapt to new and different equipment to be successful in school and in the work place.

In addition to examining hardware and its applications, the vendors should also be investigated. The following three items should be considered when investigating vendors:

- *Training and support.* How many full-time training and support specialists does the supplier employ? Does the supplier have the facilities to conduct in-house training sessions? Are training sessions conducted free of charge? If not, what is the charge?
- *Service and repair.* Does the dealer provide maintenance service for all the products sold? Are service facilities well organized? How many items are in the shop for repair? How long have they been in the shop? Is turn-around time guaranteed? Is loaner equipment available? Are items for repair picked up and delivered?
- *Reputation.* How big is the company? How long has the company been in business? How long has the company sold computers? What did the company sell before it sold computers? Has the company done business with other school districts?

ACTIVITY 4-C

Preparing Procurement Specifications

Once the selection process is completed, the result must be translated into procurement specifications. In most cases bid specifications will not be required for software, and appropriate software can be ordered. However, a specific brand of hardware may not be able to be ordered. Many organizations and educational collaboratives offer assistance in preparing bid specifications and in procuring hardware at discounted prices.

Projecting hardware costs, at least for the first year, should be based on the instructional applications to be initiated. Following the steps suggested in this chapter's Activity 4-B, "Establishing the Selection Criteria and Process: Acquiring Hardware," will result in an accurate estimate of the number of computers needed. Projecting other related costs may be more difficult. The following estimates may be helpful in calculating the cost of software and peripheral equipment:

Item	*Percent of total budget*
Equipment (basic unit)	60
Hardware peripherals	10
Software	20
Maintenance and security	10

Over time the percentage of the budget allocated to software will rise, while that for hardware will diminish.

Other factors to be considered in estimated costs include the following:

- *Leasing.* The burden of large up-front computer costs may be reduced through a lease-purchase arrangement for equipment.
- *Hardware.* Experts estimate that the costs of a given amount of computer capability is diminishing by 20 percent to 30 percent per year. Projections need to reflect this fact.
- *Obsolescence.* While the "wear life" of most hardware will be about five to seven years, some hardware may be relatively less useful for specific applications within three to four years. Equipment that is no longer useful for one application may be assigned to another, less demanding one.
- *Security and insurance.* Most hardware should be protected against theft and vandalism. In addition, separate insurance policies for hardware may be necessary. Estimated costs should include both one-time and continuing expenses for security and insurance.

CHAPTER 4 CHECKLIST

Acquiring Hardware and Software

Before moving on to Chapter 5, "Organizing and Implementing the Program," the hardware and software subcommittee should be sure that:

Criteria and procedures for evaluating and selecting software have been established. ☐

Criteria and procedures for evaluating and selecting hardware have been established. ☐

Specifications for procuring appropriate software and hardware have been prepared. ☐

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*Tinker, Robert. "Software Evaluation: Are We Missing the Forest for the Trees?" *Hands On!* Vol. 6 (spring, 1983), 3.

"Tracking Down the 'Right' Computer," *Electronic Learning,* Vol. 3 (January, 1984), 39—49.

*Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

EXAMPLE 4-1

Software Documentation Checklist

1. Software title _____
2. Version _____
3. Producer _____
4. Cost _____ 5. Subject area _____
6. Specific topic _____ 7. Grade level _____
8. Application: ___ Direct instruction ___ Instructional management
9. Mode of instruction: ___ Simulation ___ Drill and practice ___ Other
   ___ Tutorial ___ Problem-solving
   ___ Game ___ Demonstration
10. Medium of transfer: ___ 5¼-inch disk ___ Tape casette ___ Other
    ___ ROM (read only memory) cartridge ___ 8-inch disk
11. Required hardware:
    Microcomputers _____
    Printer _____
    Disk drive/cassette/ROM (read only memory) _____
    Joy stick, graphics tablet, other peripheral equipment _____
12. Required software and operating system _____
    _____
13. Average time for student to complete the program _____
14. Has the program been evaluated? ___ Yes ___ No
    If yes, cite source. _____
15. Has the software been previewed? ___ Yes ___ No

EXAMPLE 4-2

Applications Criteria Checklist

	Yes	*No*
1. Is the software targeted toward helping students achieve competencies?	_____	_____
2. Are the software objectives compatible with the objectives of the overall curriculum?	_____	_____
3. Is the software compatible with the other instructional materials to be used?	_____	_____
4. Do the software objectives include specific skills (for example, knowledge, comprehension, application, analysis, synthesis) to be taught?	_____	_____
5. Is the function of the software (for example, mainline or supplementary instruction) compatible with how it is to be used?	_____	_____
6. Can the software objectives be achieved more efficiently using traditional instructional materials?	_____	_____
7. Can the teacher effectively perform the tasks required by the software objectives?	_____	_____
8. Can the software accommodate the instructional grouping approach (for example, individual, small group, large group) for which it will be used?	_____	_____
9. Is the readability level of the text appropriate for the students who will use it?	_____	_____
10. Can the software be adapted to include different content or responses?	_____	_____

EXAMPLE 4-3

Software Evaluation Criteria Checklist

	Yes	*No*
General		
1. Is this an effective use of the computer?	_____	_____
2. Is the purpose of the program well defined?	_____	_____
3. Are the objectives stated in terms of the student's performance?	_____	_____
4. Is the range and scope of content adequate to achieve the program's intent?	_____	_____
5. Is the program technically sound, free of programming errors, and easy to operate?	_____	_____
6. Does the program provide a useful summary or report of the student's performance?	_____	_____
7. Is the program free of excessive competition and violence?	_____	_____
8. Is the program free of racial, sex, and ethnic stereotypes?	_____	_____
9. Is the documentation sufficient?	_____	_____
Instructional Design		
1. Is the content factually correct?	_____	_____
2. Is the presentation logical and well organized?	_____	_____
3. Are the interest level, difficulty level, and vocabulary level compatible?	_____	_____
4. Can the instructor modify the program?	_____	_____
5. Are graphics and sound used appropriately to enhance instruction?	_____	_____
6. Are instructions clear, complete, and concise?	_____	_____
7. Can the user skip instructions and return to them (HELP) as needed?	_____	_____
8. Is the user told how to end the program, start over, or reenter where the user left off?	_____	_____
9. Can students operate the program easily and independently?	_____	_____
10. Are support materials, such as worksheets, provided?	_____	_____
Program Design		
1. Is the instructional text formatted for screen display?	_____	_____
2. Is the amount of text appropriate?		
3. Does the software use the special capabilities of the computer?	_____	_____
4. Is content sequencing adaptable according to the teacher's or student's preferences?	_____	_____
5. Does the program provide for student feedback?	_____	_____
6. Can the student control the program?	_____	_____
7. Are exercises randomly generated?	_____	_____
8. Is the program "crash-proof"? That is, is it impossible for a student to halt the operation of the program by hitting the wrong key or responding incorrectly?	_____	_____
9. Is the response time acceptable?	_____	_____
10. Is the program loading time acceptable?	_____	_____

CHAPTER 5

Organizing and Implementing the Program

Recent research and experience testify to the importance of planning for program implementation. A districtwide program that is developing over a three-to-five-year planning period requires detailed attention to organization and implementation. This chapter outlines the three major tasks that need to be undertaken:

1. Providing for program coordination and implementation
2. Developing the logistical support system
3. Developing the materials and equipment support system

ACTIVITY 5-A

Providing for Program Coordination and Implementation

While the planning committee is primarily responsible for coordinating program development, a committee is not the most efficient means for coordinating program implementation. Ideally, one individual has been designated as the organization and implementation director responsible for overall program management.

The organization and implementation director is responsible for implementing the plan that has been developed by the committee. This plan should be based on the implementation plan outlined in Example 1-3B, "Superintendent's Work Statement."

In order to put all elements into operation, the implementation director should schedule detailed, specified, and sequenced activities. A time line may be needed. Scheduling methods can range from simple to complex; some project management systems require using a computer for development and maintenance. Examples 5-1 and 5-2, "Staging and Phasing of Computer Applications," and "Staging and Phasing of Staff Development Activities," illustrate three-year implementation schedules. Because they describe broad program directions, these forms can be used when making presentations to the school district governing board.

Many factors are critical to implementing successfully change in schools. When putting plans into effect, the director should do the following:

- Keep faculty members informed of program implementation activities throughout the school and district. Keeping the faculty members informed will help in faculty training efforts.
- Schedule meetings during which faculty members can discuss implementation difficulties with colleagues and share ideas for dealing with them. Use these sessions to ensure that everyone has a clear understanding of the program.
- Encourage and support the principal in the role of a facilitator and resource person to the faculty.
- Encourage teachers to prepare or adapt instructional materials for their own use. They may need time to practice using the courseware on the computer.
- Pay attention to what is actually happening in the classrooms. Ensure that actual implementation is going according to plans. If not, find out why.
- Document implementation activities. What problems were encountered? How were they solved?
- Encourage the central office staff to support faculty members.
- Develop a plan for managing courseware and software.

The following four areas merit additional attention:

1. *Training.* Training is not a one-time effort but a continual process with an agenda dictated largely by information obtained from monitoring the

program implementation. The planning committee should communicate clearly to the superintendent and the school board that successful implementation and expected student performance cannot be realized without continual and responsive staff development.

2. *The principal's role.* The opportunities for a substantive leadership role are many. The principal should have sufficient technical knowledge to assist staff or to decide what technical assistance is needed. He or she should take an active role in the development and implementation of the curriculum and serve as a consultant to the teachers in integrating the computer into the existing curriculum. Most important, the principal should monitor program implementation, note problems and unanticipated outcomes, and provide staff with necessary support. These tasks are essential to the successful implementation of such a complex and innovative program.

3. *Program evaluation.* Two types of evaluation data should be collected in order to fine tune the computer program and make judgments on its effectiveness. First, implementation should be monitored. Monitoring can be accomplished through checklists, observations, and discussions with teachers. Implementation falters when teachers are not clear about the specific activities required to implement a program. A simple checklist of indicators may serve as a teacher's guide. The checklist may also serve as a self-administered instrument that enables teachers to identify implementation problems to be addressed through additional training sessions.

   While the primary reason for evaluating the program is to assess student performance, the teacher's performance or the performance of other personnel may also be assessed. The performance to be measured should be specified in the plan and can range from students' ability to operate the computer, to specific knowledge or skills acquired while using software, to the ability to program. If computer activities are well integrated in the curriculum, assessing changes in student performance directly related to computer studies will be difficult. Most changes in peformance directly related to computer studies may have to be measured with custom-designed tests because commercial instruments are not yet widely available. For assessing skills such as writing, critical thinking, or problem solving and for evaluating subject-area knowledge, traditional commercial tests may work well.

4. *Courseware and software management.* The growing courseware and software collection should be centrally managed and distributed to teachers as needed. The resource librarian is an appropriate distribution manager. The expense of a comprehensive courseware and software collection and restrictions on software copying may require a districtwide distribution system.

ACTIVITY 5-B

Developing the Logistical Support System

In a logistical support system, hardware and software are allocated to applications specified in the computer program plan. Because the number of computers will be fewer than the number of applications, a distribution and scheduling system should be used for each school in the district. Most computers should be centrally housed and checked out as any other piece of valuable equipment. The self-contained computer lab where students can learn basic computer skills or use the computers to do assigned work in a subject area is an exception to this recommendation.

The logistical plan, such as the one in Example 5-3, "Hardware and Software Distribution Plan," should specify what equipment will be used and by whom. In many cases this plan can be managed by a teacher.

Computer locations will affect how students and teachers use them. The existence of a computer lab could indicate to students that the computers are a separate course of study that is unrelated to other subjects. Students should be encouraged to use the computer lab to complete assignments in other subjects. Sample assignments might be using a word processor to prepare a report, using a graphics program to prepare charts, or using a tutorial program to practice vocabulary in a foreign language. The link between the computers in the classroom and those in the lab must be strengthened in order to integrate computers into the total curriculum. To support this objective logistically, teachers may need a scheduling system for assigning students to a lab.

The placement of equipment should match the instructional application. For example, teacher-directed demonstrations, individualized tutorials, and ad hoc student uses may require only a single computer in a classroom. Word processing, programming instruction, and computer-assisted learning (CAL) lessons may require at least one computer for every two students. (Such a requirement might be met by having a computer lab or several computers in a classroom.)

ACTIVITY 5-C

Developing the Materials and Equipment Support System

Computers and courseware are highly susceptible to damage and theft. The materials and equipment support system can ensure that adequately operating hardware and software are available to support the program. The organization and implementation director should ensure that the following tasks are accomplished:

1. Mark all equipment and store it in secure facilities when not in use. The planning budget should include cost estimates for installing security systems.
2. Insure equipment separately and list all equipment on the district's master list of insured equipment.
3. Inventory each piece of equipment in the district and note its location. A similar inventory of courseware also should be prepared.
4. Establish a maintenance schedule. Maintenance and repair contracts are usually available from the computer distributor or from special repair facilities. As the amount of equipment increases, consider hiring a technician to take care of minor maintenance. Larger districts may prefer to hire a technician for all maintenance. Cooperative arrangements for maintenance should also be explored.

CHAPTER 5 CHECKLIST

Organizing and Implementing the Program

Before moving on to Chapter 6, "Looking Ahead," the organization and implementation director should be sure that:

Procedures for program coordination and implementation have been provided. ☐

A logistical support system has been developed. ☐

A materials and equipment support system has been developed. ☐

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*Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

EXAMPLE 5-1

Staging and Phasing of Computer Applications

Student Competencies and Subject Areas

Grade levels	*1985-86*	*1986-87*	*1987-88*
K—3			
4—6			
7—9			
10—12			

EXAMPLE 5-2

Staging and Phasing of Staff Development Activities

Target Groups

Training levels	*1985-86*	*1986-87*	*1987-88*
Level I Training			
Level II Training			
Level III Training			

EXAMPLE 5-3

Hardware and Software Distribution Plan

[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1	Benson	Word processing	Apple IIe (2)	Bank Street Writer
1	Marks	Scientific measurement	Timex with interface boards (6)	Measuring and plotting devices
3	Jones	Graphing population shifts	Commodore (4)	Graphics
3	Harris	Searching on-line databases	Apple IIe with modem (1)	Micro-Courier

CHAPTER 6

Looking Ahead

At this point the planning and implementation cycle should be completed for the first time—in some areas quite thoroughly, in others, only superficially. For example, while the philosophy and mission statement and the general student competencies may be well specified, additional work may still be needed to develop new instructional applications and staff development techniques and to accommodate new hardware and software.

Because computer technology and knowledge of it change so rapidly, the plan developed during the first cycle may become obsolete sooner than the computer hardware it addresses. Technological advances in equipment and applications require plans to be refined and restructured.

Repeating the planning cycle requires information about the implementation of the first plan and its impact on established curriculum objectives. Thus, program monitoring and evaluation information is critical to the success of the next planning cycle. Because the planning cycle must continue, those directing the planning effort should consider establishing a standing planning committee and appointing several new members.

However, now that the first cycle is finished, the steps involved in the planning process should be reviewed. The "Completed Planning Process Checklist" below outlines those activities. Those directing the planning effort should use this checklist to monitor and assess the computer instruction program or to explain the program to the principal, school board members, or others.

Completed Planning Process Checklist

Chapter 1
Conducting Preliminary Planning Activities

- The planning committee has been formed. ☐
- Broad direction has been established by developing a philosophy and policy statements. ☐
- Orientation activities have been designed and started. ☐
- Current computer applications have been inventoried. ☐
- Planning resource needs have been identified ☐

Chapter 2
Integrating Computers into the Curriculum

- Broad goal statements have been developed. ☐
- Student competency statements have been developed. ☐
- Planning priorities have been set. ☐
- Curriculum objectives have been developed. ☐
- Instructional strategies and applications have been developed. ☐

Chapter 3
Delivering Staff Development Services

- Required competencies for the faculty have been identified. ☐
- Actual competencies needed by the faculty have been determined. ☐
- A staff development program has been established. ☐

Chapter 4
Acquiring Hardware and Software

- Selection criteria and the process for acquiring software have been established. ☐
- Selection criteria and the process for acquiring hardware have been established. ☐
- Procurement specifications have been prepared. ☐

Chapter 5
Organizing and Implementing the Program

- Program coordination and implementation have been provided. ☐
- The logistical support system has been developed. ☐
- The materials and equipment support system has been developed. ☐

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•Asterisked publications are available at the Teacher Education and Computer (TEC) centers. See Appendix C for locations.

APPENDIX A

Selected Periodicals

The periodicals listed here provide educators with timely, relevant information on computers. An asterisk (*) next to an entry indicates that the annotation was adapted from the *Classroom Computer Learning Directory of Educational Computing Resources,* © 1983, by Pittman Learning, Inc., 19 Davis Dr., Belmont, CA 94002, and is used with permission.

**ACM SIGCUE Bulletin,* Computer Uses in Education, Association for Computing Machinery (ACM), 11 W. 42nd St., New York, NY 10036.

The *Bulletin* contains articles, reviews, and information of use to educators interested in computers. Practical guides to preparing computer-based instructional materials and reports of research on computer-assisted learning are often included. The *Bulletin* presents interviews with leaders in educational computing and information on conferences and current projects.

**AEDS Journal* and *AEDS Monitor,* Association for Educational Data Systems (AEDS), 1201 16th St. N.W., Washington, DC 20036.

This journal features reports on original research, project descriptions and evaluations, and articles on the educational uses of computers. The *AEDS Monitor* reports bimonthly on research and applications of computers in education. Research and reviews from other groups such as ERIC (Educational Resources Information Center) and MECC (Minnesota Educational Computer Consortium) are regularly included.

Classroom Computer Learning, Pitman Learning, Inc., 19 Davis Dr., Belmont, CA 94002.

Formerly *Classroom Computer News,* this periodical links computer-based learning with traditional classroom instruction. Published nine times during the school year, the magazine includes teacher-developed classroom ideas, articles that include original programs, software reviews, and a pullout poster. Manufacturers' information on new products and a calendar of events also appear in each issue. Two of the issues are directories; one lists educational computer resources, and the other lists sources of educational software.

Compukids, 1709 West Broadway, Sedalia, MO 65301.

Compukids, a magazine for young people ages seven through seventeen, is published monthly. Each issue includes articles about computers; reviews on new hardware, software, and publications; and short lessons on computer history or programming. Compukids is also the name of a club, whose yearly membership fee includes a subscription to *Compukids.*

**Computers in Education,* Studebaker Technology, 189 Newton, Glen Ellyn, IL 60137.

This monthly newsletter focuses on selecting, acquiring, and using computers in schools. The newsletter also contains information about funding, software, research, and support manuals.

**Computers in the Classroom,* 3 Carlaw Ave. Toronto, Ontario, Canada M4M 2R6.

Each subscription to this Canadian publication includes a copy of the *Canadian Educational Courseware Software Directory* and *Daily Journal. Computers in the Classroom* contains book and software reviews, a question and answer column, and articles on computer languages.

Computertown, USA! P.O. Box E, Menlo Park, CA 94025.

This news bulletin is written for members of public-access computer literacy projects around the world and is published bimonthly.

**The Computing Teacher,* International Council for Computers in Education (ICCE), University of Oregon, 1787 Agate St., Eugene, OR 97403.

The Computing Teacher publishes general and technical articles on the instructional uses of computers. *The Computing Teacher* also includes programming suggestions; computing problems; software and book reviews; and news items on conferences, projects, resource centers, and technological developments in computers.

**Creative Computing,* 39 E. Hanover Ave., Morris Plains, NJ 07960.

Creative Computing focuses on both the general and technical aspects of computers. Special issues about educational applications of computing include resource and software reviews. The monthly periodical presents articles on programming techniques and applications, high-level languages, games, and the impact of computers on society. Two volumes of *The Best of Creative Computing* are available.

CRLA: Computers, Reading, and Language Arts, P.O. Box 13247, Oakland, CA 94661.

In this quarterly written for educators, authors describe educators' experiences with innovative approaches to using computers in teaching. Articles also focus on educational research and suggestions for evaluating software.

C.U.E. Newsletter, P.O. Box 18547, San Jose, CA 95858.

Computer-Using Educators (C.U.E.) publishes this bimonthly newsletter of interest to computer educators. The newsletter includes announcements, letters, and software and hardware reviews.

Educational Magazine, Edcomp, Inc., P.O. Box 535, Cupertino, CA 95015.

This magazine, designed for educators who use computers in the classroom, focuses on the benefits and problems of instructional computing. Each issue includes book and educational software reviews, an advice column, and a calendar of upcoming conferences.

Educational Technology, 140 Sylvan Ave., Englewood Cliffs, NJ 07632.

This long-established monthly focuses on educational uses of technology. Each issue contains columns on educational computing. Special issues feature articles that contain examinations of classroom use of technology, as well as detailed reviews of books, materials, and products. *Educational Technology* highlights commercially available courseware. Columnists comment on specific developments in educational technology.

Electronic Education, Electronic Communications, Inc., Suite 220, 1311 Executive Center Dr., Tallahassee, FL 32301.

Electronic Education informs school administrators and educators from middle school through college about the uses of technology in education. Authors discuss technological aplications in schools, new products, trends, and interview prominent educators.

Electronic Learning, Scholastic, Inc., 730 Broadway, New York, NY 10003.

Electronic Learning publishes nontechnical articles on educational computing applications. News columns focus on innovative uses of computers in education. Educators evaluate commercial software and discuss classroom applications. Regular features include a primer for teachers with minimal computer literacy, teachers' suggestions for simple computer-based classroom activities, and guides to proposal writing and funding sources.

ERIC/IR Update, Syracuse University, ERIC Clearinghouse on Information Resources, School of Education, Syracuse, NY 13210.

This semiannual bulletin focuses on selected microcomputer-related items from the ERIC microfiche collection as well as on books available from commercial publisher.

ETC, Far West Laboratory, 1855 Folsom St., San Francisco, CA 94103.

The *Educational Technology and Communication (ETC)* newsletter is published monthly. *ETC* includes a column that answers readers' questions and information about computing resources, upcoming comferences, and new publications and describes classroom application of computers.

Hands On! Technical Education Research Centers (TERC), 8 Eliot St., Cambridge, MA 02138.

Each issue contains programs, book and software reviews, news on conferences, and an idea exchange forum. Two new columns are called "Classroom Computing" and "Tools of the Trade." *Hands On!* is published four times a year.

Infoworld, 530 Lytton Ave., Palo Alto, CA 94301.

Geared to small computer owners, this weekly newstabloid focuses on developments in microcomputers and educational software. *Infoworld* also contains reports on computer graphics, databases, and new technology. A subscription includes the quarterly *Software Report Card*.

Instructional Innovator, Association for Educational Communications and Technology (AECT), 1126 16th St. N.W., Washington, DC 20036.

Instructional Innovator features articles on new aspects of educational technology. Free to AECT members, *Instructional Innovator* contains articles on educational computing, and special issues contain reports on educational uses of microcomputers. Articles and a new products section regularly contain descriptions of hardware. The publication also contains announcements of bibliographic searches and reports available from the ERIC database.

Interface: The Computer Education Quarterly, 915 River St., Santa Cruz, CA 95060.

Written for computer science and data processing educators, *Interface* includes book reviews and programming tips. Authors discuss curricula and methodologies involved in teaching about computers.

Interface Age, 16704 Marquardt Ave., Cerritos, CA 90701.

This periodical contains information on hardware and software and new products as well as a regular column on educational applications of computers. Authors discuss information useful to novice as well as experienced users of computers.

Journal of Computer-Based Instruction, ADCIS (Association for the Development of Computer-Based Instructional Systems), Western Washington University, 409 Miller Hall, Bellingham, WA 98225.

Free to members of ADCIS, the *Journal* is a professional quarterly containing articles, lectures, and reports. Authors discuss research findings and surveys in the field of computer-based instruction in elementary and secon-

dary schools, colleges, business, the armed forces, and governmental agencies..

**Journal of Educational Technology Systems,* Baywood Publishing Co., Inc., Box D, 130 Marine St., Farmingdale, NY 11735.

This quarterly journal focuses on curriculum and program development. Authors discuss the technical aspects of educational programs, curriculum projects, and instructional support systems.

Link and Go, The Committee of Personal Computers and the Handicapped, 2030 Irving Park, Chicago, IL 60618.

Link and Go is a quarterly newsletter that provides a means for people interested in how personal computers can be used by the handicapped to exchange information.

**The Logo and Educational Computing Journal,* Suite 219, 1320 Stony Book Rd., Stony Brook, NY 11790.

Targeted at teachers currently using microcomputers in their classrooms, the focus of the magazine is on versions of the LOGO language. The editors welcome readers' research findings and comments on computer-assisted instruction.

**Microcomputers in Education,* Queue, Inc., 5 Chapel Hill Dr., Fairfield, CT 06432.

Queue, a software distributor, publishes this monthly newsletter, which focuses on the commercial educational software. Besides describing new educational programs available from Queue, authors summarize software reviews from other magazines and note where the reviews first appeared. *Microcomputers in Education* regularly contains announcements of new products, publications, workshops, and projects. Subscribers receive a 10 percent discount and 30-day return privileges on all software ordered from Queue.

**National Educational Computer Review,* National Educational Computer Library (NECOL), P.O. Box 293, New Milford, CT 06776.

This newsletter published by NECOL contains reports on conferences and new trends in educational computing and reviews on books, periodicals, and software.

**Newsletter of the Consortium on Uses of Computers in Mathematical Sciences Education,* Math Sciences Department, 14 Memorial Hall, University of Delaware, Newark, DE 19711.

Available free from the Consortium on the Uses of Computers in Mathematical Sciences Education, this newsletter is written for educators at all levels.

**Nibble,* Box 325, Lincoln, MA 01773.

Nibble contains listings of program applications and uses, particularly of programs that are designed to be used in business, finance, and education. *Nibble* also contains software reviews and columns on education, graphics, and beginning programming.

Personal Computing, P.O. Box 13916, Philadelphia, PA 19101.

Personal Computing contains nontechnical articles on using computers in business, schools, and homes. Regular features on educational computing include topics such as literacy, districtwide planning, and specific applications.

**Pipeline,* Conduit, P.O. Box 388, Iowa City, IA 52244.

Published twice yearly by Conduit, *Pipeline* offers ideas for educational uses of computers. Each issue contains descriptions of materials Conduit has reviewed and tested—some appropriate for use in secondary schools. (These materials can be ordered from Conduit.)

Popular Computing (formerly *On Computing*), Byte Publications, 70 Main St., Peterborough, NH 03458.

Nontechnical articles about microcomputers for educational, business, and home use are featured in this periodical. *Popular Computing* includes reviews of new products, book reviews, question and answer columns, and a regular column on computers in education. *Popular Computing* frequently includes articles written especially for educators.

**School Microcomputer Bulletin,* Learning Publications, Inc., c/o Book Marketing Services, 3030 S. Ninth St., Kalamazoo, MI 49007.

A recent publication, *School Microcomputer Bulletin* focuses on computing concepts and trends. *School Microcomputer Bulletin* is written specifically for educators.

SchoolTech News, Education News Service, P.O. Box 1789, Carmichael, CA 95609.

This eight-page newsletter reports the latest news about new technology for use in elementary and secondary schools. Regular features include software and hardware reviews and reviews of new publications, reports on major conferences, interviews, and synopses of articles on computer technology from other publications. *SchoolTech News* is published monthly during the school year.

**Teaching and Computers,* Scholastic, Inc., 730 Broadway, New York, NY 10003.

Geared to elementary school teachers, *Teaching and Computers* provides information and practical suggestions for integrating computers into the classroom. It includes nontechnical information on teacher-developed ideas for lessons and information about new books and resources.

T.H.E. Journal (Technology Horizons in Education), P.O. Box 17239, Irvine, CA 92713.

Published eight times a year, the *T.H.E. Journal* focuses on the theoretical and practical aspects of educational technology. Reviews of software, projects, and publications are linked to an inquiry service card so that readers

can send for additional information. Articles focus on the use of educational technology.

TLC (Teaching, Learning, Computing), Seldin Publishing Company, 1061 S. Melrose, Suite D, Placentia, CA 92670-7180.

TLC is geared to teachers of kindergarten through grade twelve and features reviews of new products and books as well as regular columns. Articles focus on such issues as equity, ethics, and curriculum development. Actual classroom practices are used as examples.

APPENDIX B

Software for Educators

The following groups are among many that review or provide software or both:

Conduit, P.O. Box 388, Iowa City, IA 52244.

Conduit reviews and distributes software. Although primarily concerned with software for use in college classes, Conduit reviews and distributes programs that are appropriate for advanced high school mathematics and science classes. Conduit sponsors a project to convert mainframe and minicomputer programs for use on microcomputers. Conduit publishes an authors' guide that is used as a model to develop and evaluate software. Conduit also publishes a biannual magazine, *Pipeline*.

EPIE (Educational Products Information Exchange) Institute, P.O. Box 620, Stony Brook, NY 11790.

The EPIE Institute is an advocacy group whose members analyze curricula of elementary and high schools and provide training seminars for schools. EPIE, in association with the Microcomputer Resource Center at Teachers College, Columbia University, has formed the Microcomputer Software File, which contains reviews of commercially available software programs, including reviews of six of the larger computer-based instructional programs as well as a number of microcomputer games. A microcomputer file on hardware is also being developed. The institute also publishes an educational consumers' newsletter, *EPIEgram*, that reports on inferior and unsafe equipment and runs in-depth reviews of sources of information on computers in education.

Microcomputer Software and Information for Teachers (MicroSIFT), Northwest Regional Educational Laboratory, 300 6th Ave. S.W., Portland, OR 97204.

MicroSIFT is a clearinghouse for descriptive and evaluative information about microcomputer-based software packages for education. MicroSIFT has established procedures for evaluating the content and instructional and technical quality of instructional packages. The information is disseminated in print form through state and local educational agencies and some commercial and professional periodicals. MicroSIFT is also available as a database on the Bibliographic Retrieval Services System. Technical assistance to educational agencies is available under contract.

Softswap, c/o Ann Lathrop, Library Coordinator, Office of the San Mateo County Superintendent of Schools, 333 Main St., Redwood City, CA 94063.

Softswap, a joint project of the Microcomputer Center of the Office of the San Mateo County Superintendent of Schools and Computer-Using Educators (CUE), receives donations of educational software in the public domain and evaluates and refines the programs. The programs are available free of charge to educators who copy them onto their own disks at the Microcomputer Center. Softswap also operates as a software exchange. Any educator who contributes an original program on a disk may request any Softswap disk in exchange. In addition, Softswap sells completed disks for a nominal fee. More than 300 programs in the public domain are available.

APPENDIX C

Teacher Education and Computer (TEC) Centers

In California the Teacher Education and Computer (TEC) centers are a major resource for districts and schools that are planning for and implementing computers in the curriculum. The 15 TEC centers serve districts on a regional basis. In addition, the TECC Software Library and Clearinghouse coordinates software reviews, maintains a software library, and assists districts in evaluating and acquiring software. The Software Library and Clearinghouse operates statewide. Districts are encouraged to learn what the TEC centers offer and to take advantage of their resources. The asterisked publications listed in the Selected References are available at the TEC centers.

TEC Center, Region 1
901 Myrtle
Eureka, CA 95501
707-445-5411, Ext. 264

TEC Center, Region 2
P.O. Box 810
Red Bluff, CA 96080
916-527-5811

TEC Center, Region 3
1111 Las Gallinas Ave.
San Rafael, CA 94903
415-499-5877

TEC Center, Region 4
9738 Lincoln Village
Sacramento, CA 95827
916-363-6758

TEC Center, Region 5
2550 25th Ave.
San Francisco, CA 94116
415-664-8900

TEC Center, Region 6
313 W. Winton Ave.
Hayward, CA 94541
415-887-0152, Ext. 318

TEC Center, Region 7
801 County Center Three Ct.
Modesto, CA 95355
209-571-5298

TEC Center, Region 7
222 E. Weber
Stockton, CA 95202
209-944-3169

TEC Center, Region 8
100 Skyport Dr.
San Jose, CA 95115
408-947-6992

TEC Center, Region 9
535 E. Main St.
Ventura, CA 93009
805-654-2164

TEC Center, Region 10
County Government Center
Hanford, CA 93230
209-584-1441, Ext. 2935

TEC Center, Region 11
5801 Sundale Ave.
Bakersfield, CA 93309
805-398-3641

TEC Center, Region 12
9300 E. Imperial Hwy.
Downey, CA 90242
213-922-6680

TEC Center, Region 13
P.O. Box 868
Riverside, CA 92502
714-788-6684

TEC Center, Region 14
1851 N. Brookhaven
Placentia, CA 92670
714-966-1120 or 714-966-3420

Region 15 TECC Network
6401 Linda Vista Rd.
San Diego, CA 92111
619-292-3883

Imperial County TEC Center
1398 Sperber Rd.
El Centro, CA 92243
619-339-6463

California TECC Software
Library and Clearinghouse
Ann Lathrop, Library Coordinator
333 Main St.
Redwood City, CA 94063
415-363-5472

Regions of the TEC Centers

APPENDIX D

Professional Organizations and User Groups

The following list identifies some of the services and benefits available to school districts from professional organizations and user groups. (User groups—usually organized by brand of computer—exist in many communities.) Many other local resources may be available. Districts are encouraged to develop and update their own catalog of local resources.

The American Computer Science League (ACSL), March H. Brown, Director, P.O. Box 2417A, Providence, RI 02906.

ACSL administers monthly computer science contests for junior and senior high school students; publishes a monthly newsletter, which includes results of each contest and items of interest; and awards prizes to outstanding students and schools at local and regional levels. ACSL holds a team all-star contest at the end of the year, as well as individual all-star contests at various regional sites. Write to the above address for free sample problems, registration forms, and contest materials.

Association for Computing Education (ACE), 3956 O'Neill Dr., San Mateo, CA 94403.

ACE promotes the sharing of technical and managerial knowledge, skills, and experience in information processing. ACE sponsors professional development seminars that present practical materials for use in a work environment.

Association for Computing in Mathematics and Science Teaching, P.O. Box 4455, Austin, TX 78765.

This professional organization is designed for those who use computers in teaching mathematics and science in high schools and colleges. The organization also publishes the *Journal of Computers in Mathematics and Science Teaching.*

Association for Computing Machinery (ACM), 11 W. 42nd St., New York, NY 10036.

ACM has local chapters in cities around the country and sponsors the ACM Elementary and Secondary School Subcommittee and groups whose members are interested in computer science education (CIGSE) and computer use in education (SIGCUE). ACM's numerous publications, include the *ACM SIGCUE Bulletin* and the *Journal of the Association for Computing Machinery.*

Association for Educational Communication and Technology (AECT), 1126 16th St. N.W., Washington, DC 20036.

AECT promotes effective uses of media and technology in education and works to increase understanding of educational computing through a committee on microcomputers and a division for information systems and computers. Publications include the *Journal of Instructional Development* and *Instructional Innovator.* The annual membership fee includes a subscription to *Instructional Innovator.*

Association for Educational Data Systems (AEDS), 1201 16th St. N.W., Washington, DC 20036.

AEDS is a professional organization whose members include educators and data processing professionals interested in computer science and in instructional and administrative computing. Activities include workshops, seminars, and an annual convention; 25 chapters in the U.S. and Canada are affiliated. AEDS' publications include the *AEDS Newsletter,* the *AEDS Monitor,* and the *AEDS Journal.*

Association for the Development of Computer-Based Instructional Systems (ADCIS), ADCIS Headquarters, 409 Miller Hall, Western Washington University, Bellingham, WA 98225.

ADCIS encourages the efficient use of computer-based instruction and management and facilitates communication between developers and users. ADCIS's members include elementary and secondary school districts, colleges and universities, businesses, and governmental agencies. ADCIS maintains several groups active in educational technology. ADCIS publishes the *Journal of Computer-Based Instruction* and the *ADCIS Newsletter.*

Center for Research on Learning and Teaching (CRLT), Karl Zinn, 109 E. Madison St., Ann Arbor, MI 48104.

CRLT is a source of innovative projects and ideas for using computers in education. The group disseminates information from the Dataspan bank through various publications and professional associations. Funded by the National Science Foundation, Dataspan collects information on computer systems, local communications networks, local funding sources, professional associations, user groups, conferences, commercial organizations, public agencies, and materials in print.

Computer Science Institute, Marjorie A. Fitting, Department of Mathematics and Computer Science, San Jose State University, San Jose, CA 95192.

The Computer Science Institute performs two important functions: (1) develops software in response to teachers' requests; and (2) lends microcomputers and mathematics software to teachers.

ComputerTown, USA! (CTUSA!), Fritzi Lareau, 1263 El Camino Real, P.O. Box E, Menlo Park, CA 94025.

ComputerTowns are informal learning centers that promote computer literacy. ComputerTown, USA! provides information about existing centers and helps establish new centers around the country. CTUSA! publishes a newsletter, which is included in the annual membership fee, and offers local courses and workshops.

Computer-Using Educators (CUE), Leann Paterson, P.O. Box 18547, San Jose, CA 95158.

CUE, a California-based organization with members around the country, seeks to increase the use of computers in schools and colleges. Activities include organizing major conferences and publishing a bimonthly newsletter.

Educational Technology Center, University of California, Irvine, Irvine, CA 92717.

The Educational Technology Center maintains several projects designed to develop computer-based materials for all levels of the curriculum. The Development of Learning Skills in Early Adolescence Project is developing computer-based modules for junior high school students, and the project on scientific literacy in public libraries is designed to improve the understanding of science.

Educational Testing Service (ETS), Technology Laboratory, Martin B. Schneiderman, Director, Rosedale Rd., Princeton, NJ 08541.

The ETS Technology Laboratory houses more than 20 microcomputers and 2,000 software packages, including many in the public domain. Seminars on instructional and administrative applications of computers are offered to elementary through higher-level educators. The laboratory also serves a clearinghouse for educational software.

ERIC (Educational Resources Information Center), National Institute of Education, Washington, DC 20208.

ERIC Clearinghouse on Information Resources, Syracuse University School of Education, 130 Huntington Hall, Syracuse, NY 13210.

ERIC abstracts, indexes, stores, and disseminates educational research findings through a network of clearinghouses, including the ERIC Clearinghouse on Information Resources. A list of research topics is available from ERIC or the ERIC Clearinghouse, and information on using computers in the classroom is available from the ERIC Clearinghouse.

Far West Laboratory for Educational Research and Development, Technology Learning Center, 1855 Folsom St., San Francisco, CA 94103.

The Far West Laboratory provides technical assistance and consultation to school districts planning to use computers for instruction and management. The laboratory and Computer-Using Educators (CUE) have developed a microcomputer bulletin board which provides information and access to other interested teachers and administrators. The laboratory publishes research findings and a newsletter and holds regular workshops and seminars.

Human Resources Research Organization (HumRRO), 300 North Washington St., Alexandria, VA 22314.

HumRRO, a nonprofit behavioral science research organization, publishes papers and reports on computer-assisted instruction. Recent publications include *Computer Literacy: Issues and Directions for 1985,* based on a joint HumRRO and Minnesota Educational Computing Consortium (MECC) Conference, and *An Approach to Integrating Computer Literacy into the K—8 Curriculum,* an initial report of the Computer Literacy Guides for Elementary and Junior High School Project. Professional papers outlining other research projects on computers in education are also available from HumRRO.

International Council for Computers in Education (ICCE), University of Oregon, Eugene, OR 97403.

ICCE is a professional organization designed for people interested in instructional computing at the precollege level. ICCE has more than 13,000 individual members and 38 organizational members. ICCE has published a series of booklets on the instructional use of computers and publishes *The Computing Teacher.*

Microcomputer Education, Applications Network (MEAN), 256 N. Washington St., Falls Church, VA 22046.

This network helps educators develop and sell software and provides information on educational microcomputer applications. Members receive the *Mean Brief,* a newsletter that includes sources of software, industry news, and an exchange column. The network also helps local districts and state agencies develop specific educational computing programs.

Minnesota Educational Computing Consortium (MECC), 3490 Lexington Ave. North, St. Paul, MN 55112.

The nation's only statewide instructional computing network, MECC provides services for students, teachers, and administrators in California public schools and colleges through the California Computing Consortium. (California school districts are eligible to subscribe to the California Computing Consortium; contact Ira Barkman at the California State Department of Education, 916-324-7241.) MECC offers in-service training and curriculum guides and develops and distributes educational software. MECC is an excellent source of software and

written materials for use with Apple II, IBM, Commodore, Radio Shack, Atari, and Acorn computers. MECC also develops computer-learning packages for use in science, mathematics, and social studies courses. Both *Users,* a bimonthly instructional newsletter listing available materials, and MECC's newsletter, *Dataline,* are free upon request.

National Audio-Visual Association, the International Communications Industries Association (NAVA/ICIA), 3150 Spring St., Fairfax, VA 22031.

NAVA/ICIA is a trade association advocating the use of educational technology. The association's market research program and newsletter offer information on funding for classroom computer use. Its annual *Audio-Visual Equipment Directory* gives details on microcomputer hardware and other technology.

National Educational Computer Library, P.O. Box 293, 16 Main St., New Milford, CT 06776.

This association serves as a national resource center for schools and a clearinghouse for information on educational computing. The National Educational Computer Library publishes a newsletter, *National Educational Review.*

National Education Association (NEA), Educational Computing Services, 4720 Montgomery Ln., Bethesda, MD 20814.

This organization provides teachers with comprehensive information about computers. In addition to assessing, endorsing, and selling software, the organization provides consultng services and in-service seminars and courses.

National School Boards Association (NSBA) Computer Alliance, John Grossi, Director, 1055 Thomas Jefferson St. N.W., Washington, DC 20007.

The NSBA Computer Alliance offers comprehensive services in educational computing. For a yearly fee members receive a monthly newsletter; a subscription to *EPIEgram* (see Appendix B, Software for Educators); opportunities to attend workshops for school administrators and board members; access to a clearinghouse of educational computer information; books at discount; a 75 percent discount on the hourly rate of Compu-Serve; a list of recommended consultants; and a subscription to current reports.

Project BEST (Basic Education Skills Through Technology), AECT, 1126 Sixteenth St. N.W., Washington, DC 20036.

Project BEST assists state educational agencies in planning for and using microcomputers. (In California, contact Frank Wallace at the California State Department of Education at 916-324-1859.) Federal, state, and local governments; educational associations; commercial manufacturers; and publishers participate in Project Best and exchange information and materials.

Society for Applied Learning Technology (SALT), 50 Culpepper St., Warrenton, VA 22186.

SALT serves professionals who work with instructional technology. SALT disseminates information on technological innovations. Proceedings from SALT-sponsored conferences as well as books on microcomputers in education and educational technology are available. Publications include the *SALT Newsletter* and the *Journal of Educational Technology Systems.*

Technical Education Research Centers (TERC), 8 Eliot St., Cambridge, MA 02138.

TERC researches and develops educational applications of computers. In addition to maintaining a computer resource center and publishing a free newsletter, *Hands On!* TERC sponsors projects to develop software, hardware, science, and electronics curricula; evaluate software; and improve telecommunications. TERC offers a series of local, regional, and national workshops on microcomputers in education. TERC has also published an inexpensive guide, *Microcomputers in Education: An Introduction.* This publication is available at the TEC centers listed in Appendix C.

APPENDIX E

Assembly Bill 803 (1983) Dissemination Projects

Through funds provided by Assembly Bill 803, 14 educational technology or exemplary cooperative staff development projects disseminate information about their programs to schools and help schools evaluate and implement the programs' most successful practices and features. Schools should contact the projects for more information.

Articulation in Math and Science (AIMS), South San Francisco Unified School District, 398 B St., South San Francisco, CA 94080.

This program links high school and community college math, science, and technology curricula and helps to improve teachers' instructional skills in these areas.

CLEATS (Computer Literacy Education All Teachers and Students), Stephen M. White Junior High School, 22102 S. Figueroa St., Carson, CA 90745.

This computer lab helps establish computer learning projects in school districts.

Project COACH. Newport-Mesa Unified School District, 425 E. 18th St., Costa Mesa, CA 92627.

This program provides staff training materials to assist teachers in developing the skills to use technology effectively.

Computer Curriculum Cadre: Frederic Burk Foundation, Inc., San Francisco State University, 1640 Holloway Ave., San Francisco, CA 94132.

Teachers serve as computer specialists and computer curriculum developers.

Computer Literacy for Elementary Schools, Third Street Elementary School, 201 South June St., Los Angeles, CA 90004.

This program integrates computer awareness and programming skills in the total school curriculum.

The Cupertino Concept: Computer Literacy. Cupertino Union Elementary School District, 10301 Vista Dr., Cupertino, CA 95014.

This program provides training, lessons, and materials in all subject areas.

Cooperative Project in Teaching for Thinking/Project Impact, Office of the Orange County Superintendent of Schools, P.O. Box 9050, Costa Mesa, CA 92626.

A training program for teachers, this project teaches specific thinking skills in conjunction with regular subjects.

Elementary Aerospace Technology (EATS), Los Angeles Unified School District, 632 N. Madison Ave., Los Angeles, CA 90004.

This project teaches students to use research and experience to improve basic skills.

Generic Problem-Solving Instruction (GPSI), TEC Center, Region 9, 535 E. Main St., Ventura, CA 93009.

This program trains teachers to teach the application of a generic problem-solving process to a variety of situations.

MOST-TEC (Maximizing Opportunity for Students and Teachers Through Technology) Phase II: Dissemination, Office of the Fresno County Superintendent of Schools, 2314 Mariposa St., Fresno, CA 93721.

This program disseminates innovative educational television programs in computer literacy, mathematics, and the creative arts.

North Coastal Mathematics/Science Network, Office of the San Diego County Superintendent of Schools, 6401 Linda Vista Rd., San Diego, CA 92111.

This program distributes a team-training staff development model designed to improve instruction and keep pace with technology.

PASS on PASS, Office of the Stanislaus County Superintendent of Schools, 801 County Center Three Ct., Modesto, CA 95355.

This project trains teachers to develop computer software using the PASS authoring system.

Peninsula Academies, Sequoia Union High School District, 480 James Ave., Redwood City, CA 94062.

This program sponsors staff development programs in computer literacy and assertive discipline techniques.

Teaching Writing and Problem Solving with Computers, Goleta Union Elementary School District, 401 N. Fairview Ave., Goleta, CA 93117.

This program trains staff members to use computers as an instructional tool for teaching writing and problem solving.

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